# 2 DESCRIPTION AND COMPARISON OF ALTERNATIVES

**Alternatives Considered in This EIS**

***No Action:*** NEPA regulations require evaluation of a no action alternative. In this EIS, the no action alternative is storage of $DUF_6$ cylinders indefinitely in yards at the Portsmouth and ETTP sites, with continued cylinder surveillance and maintenance activities.

***Proposed Action:*** Construction and operation of a conversion facility at the Portsmouth site for conversion of the Portsmouth and ETTP $DUF_6$ inventories into depleted uranium oxide (primarily $U_3O_8$) and other conversion products.

***Action Alternatives:*** Three action alternatives focus on where to construct the conversion facility within the Portsmouth site (Alternative Location A, B, or C). The preferred alternative is Location A.

Alternatives for building and operating a $DUF_6$ conversion facility at the Portsmouth site were evaluated for their potential impacts on the human and natural environment. This EIS considers the proposed action of building and operating a conversion facility for conversion of the Portsmouth and ETTP $DUF_6$ cylinder inventories and a no action alternative. Under the proposed action, three action alternatives are considered that focus on where to construct the conversion facility within the Portsmouth site. The action alternatives include the shipment of $DUF_6$ and non-$DUF_6$ cylinders currently stored at ETTP to Portsmouth. In addition, the construction of a new cylinder storage yard at Portsmouth, if required for ETTP cylinders, is considered. The no action alternative assumes that a conversion facility is not built at Portsmouth and that the cylinders would continue to be stored indefinitely at Portsmouth and ETTP in a manner consistent with current management practices. This chapter defines these alternatives and options in detail and discusses the types of activities that would be required under each. A summary of the alternatives considered in this EIS is presented in Table 2.1-1.

A separate EIS prepared for construction and operation of a conversion facility at the Paducah site (DOE 2004a) also includes a no action alternative. The no action alternative defined in the Paducah EIS includes an evaluation of the potential impacts of indefinite long-term storage of cylinders at Paducah.

In addition to describing the alternatives evaluated in this EIS, this chapter includes a discussion of alternatives considered but not analyzed in detail (Section 2.3) and a summary comparison of the potential environmental impacts from the alternatives (Section 2.4). The comparison of alternatives is based on information about the environmental setting provided in Chapter 3, descriptions of the assessment methodologies provided in Chapter 4, and the detailed assessment results presented in Chapter 5.

## 2.1 NO ACTION ALTERNATIVE

Under the no action alternative, it is assumed that $DUF_6$ cylinder storage would continue indefinitely at the Portsmouth and ETTP sites. The no action alternative assumes that DOE would continue surveillance and maintenance activities to ensure the continued

**TABLE 2.1-1 Summary of Alternatives Considered**

| Alternative | Description | Options Considered |
|---|---|---|
| No Action (Section 2.1) | Continued storage of the $DUF_6$ cylinders indefinitely at the Portsmouth and ETTP sites, with continued cylinder surveillance and maintenance. | None. |
| Proposed Action (Section 2.2) | Construction and operation of a conversion facility at the Portsmouth site for conversion of the Portsmouth and ETTP $DUF_6$ inventories into depleted uranium oxide (primarily $U_3O_8$) and other conversion products. This EIS assesses the potential environmental impacts from the following proposed activities:<br>• Construction, operation, maintenance, and D&D of the proposed $DUF_6$ conversion facility at the Portsmouth site;<br>• Transportation of $DUF_6$ and non-$DUF_6$ cylinders from ETTP to Portsmouth;<br>• Construction of a new cylinder storage yard (if required) for ETTP cylinders;<br>• Transportation of uranium conversion products and waste materials to a disposal facility;<br>• Transportation and sale of the HF conversion product; and<br>• Neutralization of HF to $CaF_2$ and sale or disposal in the event that the HF product is not sold. | *ETTP Cylinders:* This EIS considers an option of shipping cylinders at ETTP to Paducah.<br>*Transportation:* This EIS evaluates the shipment of cylinders and conversion products by both truck and rail.<br>*Expanded Operations:* This EIS discusses the impacts associated with potential expansion of plant operations by extending the operational period and by increasing throughput (by efficiency improvements or by adding a fourth process line). |
| Alternative Location A (Preferred) (Section 2.2.1.1) | Construction of the conversion facility at Location A, an area that encompasses 26 acres (10 ha) in the west-central portion of the site. | |
| Alternative Location B (Section 2.2.1.2) | Construction of the conversion facility at Location B, an area that encompasses 50 acres (20 ha) in the southwest portion of the site. | |
| Alternative Location C (Section 2.2.1.3) | Construction of the conversion facility at Location C, an area that encompasses 78 acres (31 ha) in the southeast portion of the site. | |

> **No Action Alternative**
>
> It is assumed that the $DUF_6$ cylinders would continue to be stored indefinitely at the Portsmouth and ETTP sites and that cylinder surveillance and maintenance would also continue. Impacts are evaluated through the year 2039; in addition, potential long-term (after 2039) impacts are evaluated.

safe storage of cylinders. Potential environmental impacts are estimated through the year 2039. The year 2039 was selected to be consistent with the $DUF_6$ PEIS (DOE 1999a), which evaluated a 40-year cylinder storage period (1999 through 2039). In addition, long-term impacts (i.e., occurring after 2039) from potential cylinder breaches are assessed. A similarly defined no action alternative was also evaluated in the $DUF_6$ PEIS. The assessment of the no action alternative in this EIS has been updated to reflect changes that have occurred since publication of the $DUF_6$ PEIS in 1999. Details are provided below.

Specifically, the activities assumed to occur include routine cylinder inspections, ultrasonic testing of the wall thickness of selected cylinders, painting of selected cylinders to prevent corrosion, cylinder yard surveillance and maintenance, and relocation of some cylinders. It is assumed that cylinders would be painted every 10 years. On the basis of these activities, an assessment of the potential impacts on workers, members of the public, and the environment was conducted.

Breached cylinders are cylinders that have a hole of any size at some location on the wall. The occurrence of cylinder breaches, caused by either corrosion or handling damage, is an important concern when the potential impacts of continued cylinder storage are evaluated. There is a general concern that the number of cylinder breaches at the sites could increase in the future as the cylinder inventory ages.

At the time the PEIS was published (1999), 8 breached cylinders had been identified at the three storage sites; 3 of those breaches were at Portsmouth and 4 were at ETTP.[1] Investigation of these breaches indicated that 6 of the 8 were initiated by mechanical damage during stacking; the damage was not noticed immediately, and subsequent corrosion occurred at the damaged point. It was concluded that the other 2 cylinder breaches, both at ETTP, had been caused by external corrosion due to prolonged ground contact.

For assessment purposes in this EIS, two cylinder breach cases are evaluated. In the first case, it is assumed that the planned cylinder maintenance and painting program would maintain the cylinders in a protected condition and control further corrosion. In this case, it is assumed that after initial painting, some cylinder breaches would occur from handling damage; a total of 16 breaches are estimated to occur through 2039 at the Portsmouth site and a total of 7 for the ETTP site. In the second case, it is assumed that external corrosion would not be halted by improved storage conditions, cylinder maintenance, and painting. This case is considered in order to account for uncertainties with regard to how effective painting would be in controlling

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1 An additional breach that occurred at the ETTP site in 1998 was discussed in Section B.2 of the PEIS (DOE 1999a). In the period 1998 through 2002, two additional breaches were discovered at the Paducah site. A total of 11 breaches have been identified at the Portsmouth, ETTP, and Paducah sites.

cylinder corrosion and uncertainties in the future painting schedule. In this case, the numbers of future breaches estimated through 2039 are 74 for the Portsmouth site and 213 for the ETTP site. These breach estimates were determined on the basis of historical corrosion rates when cylinders were stored under poor conditions (i.e., cylinders were stacked too close together, were stacked on wooden chocks, or came in contact with the ground). Because storage conditions have improved dramatically over the last several years as a result of cylinder yard upgrades and restacking activities, it is expected that these breach estimates based on the historical corrosion rate provide a worst case for estimating the potential impacts from continued cylinder storage. The results of this assessment were used to provide an estimate of the earliest time when continued cylinder storage could begin to raise regulatory concerns under these worst-case conditions.

The impacts to human health and safety, surface water, groundwater, soil, air quality, and ecology from uranium and HF releases from breached cylinders are assessed in this EIS. For all hypothetical cylinder breaches, it is assumed that the breach would be undetected for 4 years, which is the period between planned inspections for most of the cylinders. In practice, cylinders that show evidence of damage or heavy external corrosion are inspected annually, so it is very unlikely that a breach would be undetected for a 4-year period. For each hypothetical cylinder breach, it is further assumed that 1 lb (0.45 kg) of uranium (as $UO_2F_2$) and 4.4 lb (2 kg) of HF would be released from the cylinder annually for a period of 4 years.

The estimated numbers of future breaches at the Portsmouth and ETTP sites were used to estimate potential impacts that might occur during the repair of breached cylinders and impacts from releases that might occur during continued cylinder storage. Potential radiological exposures of involved workers could result from patching breached cylinders or emptying the cylinder contents into new cylinders. The impacts on groundwater and human health and safety from uranium releases were assessed by estimating the amount of uranium that could be transported from the yards in surface runoff and the amount that could migrate through the soil to the groundwater.

For this EIS, a reassessment of the no action alternative assumptions used in the PEIS was conducted. Recent cylinder surveillance and maintenance plans — including inspections and painting — were used to update the PEIS no action alternative assessment. The results of this reevaluation, together with a consideration of the changes in the on-site worker and off-site public populations at Portsmouth and ETTP, were used to determine the impacts from the no action alternative. Additional discussion and the estimated impacts from the no action alternative are presented in Section 5.1.

## 2.2 PROPOSED ACTION

The proposed action evaluated in this EIS is to construct and operate a conversion facility at the Portsmouth site for conversion of the Portsmouth and ETTP $DUF_6$ inventories into depleted uranium oxide (primarily $U_3O_8$) and other conversion products. Three locations within the Portsmouth site are evaluated as alternatives (see Section 2.2.1). The proposed action includes shipping the ETTP cylinders to Portsmouth and construction of a new cylinder storage yard at Portsmouth for the ETTP cylinders, if required. The conversion facility would convert $DUF_6$ into a stable chemical form for beneficial use/reuse and/or disposal. The off-gas from the conversion process would yield aqueous HF, which would be processed and marketed or converted to a solid for sale or disposal. To support the conversion operations, the emptied $DUF_6$ cylinders would be stored, handled, and processed for reuse as disposal containers to the extent practicable. The time period considered is a construction period of approximately 2 years, an operational period of 18 years, and a 3-year period for the D&D of the facility. Current plans call for construction to begin in the summer of 2004. The assessment is based on the conceptual conversion facility design proposed by the selected contractor, UDS (see text box).

**Proposed Action**

The proposed action in this EIS is construction and operation of a $DUF_6$ conversion facility at the Portsmouth site for conversion of the Portsmouth and ETTP $DUF_6$ inventories into depleted uranium oxide (primarily $U_3O_8$) and other conversion products. $DUF_6$ and non-$DUF_6$ cylinders would be transported from ETTP to Portsmouth; and a cylinder storage yard would be constructed at Portsmouth for ETTP cylinders, if required. Three alternative locations within the Portsmouth site are evaluated (Locations A, B, and C).

This EIS assesses the potential environmental impacts from the following proposed activities:

- Construction, operation, maintenance, and D&D of the proposed $DUF_6$ conversion facility at the Portsmouth site;
- Transportation of $DUF_6$ cylinders and non-$DUF_6$ cylinders from ETTP to Portsmouth;
- Construction of a new cylinder storage yard (if required) for ETTP cylinders;
- Transportation of uranium conversion products and waste materials to a disposal facility;
- Transportation and sale of the HF conversion product; and
- Neutralization of HF to $CaF_2$ and its sale or disposal in the event that the HF product is not sold.

**Conversion Facility Design**

The EIS is based on the conversion facility design being developed by UDS, the selected conversion contractor. At the time the draft EIS was prepared, the UDS design was in the 30% conceptual stage, with several facility design options being considered.

Following the public comment period, the draft EIS was revised on the basis of comments received and on the basis of 100% conceptual facility design. This final EIS identifies and evaluates design options to the extent possible.

In addition, an option of expanding operations by extending the conversion facility operational period or increasing throughput is discussed in this section.

### 2.2.1 Action Alternatives

The action alternatives focus on where to site the conversion facility within the Portsmouth site. The Portsmouth site was evaluated to identify alternative locations for a conversion facility (Shaw 2001). Potential locations were evaluated on the basis of the following criteria:

- *Current condition of the land and site preparation required*. This criterion looked at the condition of the land from a constructability viewpoint, considering factors that would increase the construction cost over the amount needed for a relatively level grassy topography.

- *Legacy environmental concerns*. This criterion looked at environmental factors that would affect construction at the site.

- *Availability of utilities.* This criterion looked at the relative difficulty of bringing services from existing plant utilities to the site.

- *Location*. This criterion looked at the advantages and disadvantages of location in relation to cylinder transport between the yards and the new facility.

- *Effect on current plant operations*. This criterion looked at how the conversion facility's location could affect existing plant operations.

- *Size*. This criterion looked at size to ensure that the required minimum amount of land would be available for construction of the conversion facility (assumed to be about 30 acres [12 ha]).

The three alternative locations identified at the Portsmouth site, denoted Locations A, B, and C, are shown in Figure 2.2-1.

#### 2.2.1.1 Alternative Location A (Preferred Alternative)

Location A is the preferred location for the conversion facility and is located in the west-central portion of the site, encompassing 26 acres (10 ha). This location has three existing structures that were formerly used to store containerized lithium hydroxide monohydrate. These warehouses, which were originally erected in the early 1950s to support construction of the Portsmouth GDP, have 4-in. (10-cm) concrete floors. The structures are made of steel and are what is now commonly called pre-engineered steel buildings. No utilities are functional in these buildings. The open field north and east of the buildings was rough graded several times; the last time was in the late 1970s. The site was also rough graded, and storm water ditch systems were installed. Two railroad spurs existed at one time in this area. One has had the track and ties removed, and the other has fallen into disrepair. This location was identified in the RFP for conversion services as the site for which bidders were to design their proposed facilities.

#### 2.2.1.2 Alternative Location B

Location B is in the southwest portion of the site and encompasses approximately 50 acres (20 ha). The site has two existing structures built as part of the gas centrifuge enrichment project that was begun in the early 1980s and was terminated in 1985. The first building is a two-story building (110,000 $ft^2$ [10,219 $m^2$] of floor) constructed of steel, with metal siding to house uranium material feed and withdrawal facilities. The facility was never placed in operation, has had major equipment removed, and is currently not utilized. The other structure was constructed at the same time as an ingress and egress portal for both vehicles and pedestrians to a fenced, secure area. It is currently not utilized. The open field to the east of the buildings was developed during the same time period; it was rough graded, and storm water systems were installed.

It should be noted that USEC is currently in the process of developing and demonstrating an advanced enrichment technology based on gas centrifuges. A license for a lead test facility to be operated at the Portsmouth site was issued by the NRC in February 2004. The lead facility would be located in the existing gas centrifuge buildings within Location B. In addition, USEC has announced that it plans to site its American Centrifuge Facility at Portsmouth, although an exact location was not identified. Therefore, Location B might not be available for construction of the conversion facility.

#### 2.2.1.3 Alternative Location C

Location C is in the southeast portion of the site and has an area of about 78 acres (31 ha). This location consists of a level to very gently rolling grass field. It was graded during the construction of the Portsmouth site and has been maintained as grass fields since then.

### 2.2.2 Conversion Process Description

This section provides a summary description of the proposed UDS conversion process and facility. The proposed UDS conversion system is based on a proven commercial process in operation at the Framatome Advanced Nuclear Power (ANP), Inc., fuel fabrication facility in Richland, Washington. The two primary sources for the information in this section are excerpts from the UDS conversion facility conceptual design report (UDS 2003a) and the UDS NEPA data package prepared for the 100% conceptual facility design (UDS 2003b).

The UDS dry conversion is a continuous process in which $DUF_6$ is vaporized and converted to a mixture of uranium oxides (primarily $U_3O_8$) by reaction with steam and hydrogen in a fluidized-bed conversion unit. The resulting depleted $U_3O_8$ powder is collected and packaged for disposition. The process equipment would be arranged in parallel lines. Each line would consist of two autoclaves, two conversion units, an HF recovery system, and process off-gas scrubbers. The Portsmouth facility would have three parallel conversion lines. Equipment would also be installed to collect the HF co-product and process it into any combination of several marketable products. A backup HF acid neutralization system would be provided to convert up to 100% of the HF acid to $CaF_2$ for storage, sale, or disposal in the future, if necessary. Figure 2.2-2 is an overall material flow diagram for the conversion facility; Figure 2.2-3 is a conceptual facility site plan. A summary of key facility characteristics is presented in Table 2.2-1.

The conversion facility will be designed to convert 13,500 t (15,000 tons) of $DUF_6$ per year, requiring 18 years to convert the Portsmouth and ETTP inventories. The total footprint of the Portsmouth processing facility would be approximately 148 ft × 271 ft (45 m × 83 m). The conversion facility would occupy a total of approximately 10 acres (4 ha), with up to 65 acres (26 ha) of land disturbed during construction (including temporary construction lay-down areas and utility access). Some of the disturbed areas would be areas cleared for railroad or utility access, not adjacent to the construction area.

$DUF_6$ cylinders would be delivered from long-term storage to the cylinder staging yard at the conversion facility by means of cylinder handling equipment already available at the site. The staging yard would accommodate short-term storage of cylinders. Cylinders in the conversion staging yard would be transferred into the conversion building airlock by using an overhead bridge crane. The cylinders would then be moved into the vaporization room to the autoclaves by an overhead monorail crane and/or rail cart. The cylinders would be loaded into autoclaves for heating and transfer of the $DUF_6$ to the conversion units.

Cylinders that could not be processed through the normal process feed system would be processed through the cylinder transfer facility. If the cylinder was overfilled, the excess $DUF_6$ would be transferred to another cylinder. This same system would be used to transfer all of the contents from unacceptable cylinders to cylinders suitable for feeding into the conversion process.

After the emptied cylinder was removed from the autoclave, a stabilizing agent would be introduced into the cylinder to neutralize residual fluoride in the heel. The cylinders would then be moved out to the staging yard for an approximate 4-month aging period so that short-lived uranium decay products in the nonvolatile heel would decay, thereby reducing potential radiation exposure during the processing of emptied cylinders. Emptied cylinders would then be reused as disposal containers or processed and disposed of as LLW.

Major conversion system components are described further in the following subsections. The plant design includes several other supporting facilities and services, including an electrical system with backup, a communications system, a deionized water system, a control system, an air supply system, a fire protection system, and a heating, ventilation, and air-conditioning system.

#### 2.2.2.1 Cylinder Transfer System

Some cylinders might be unacceptable for processing in the vaporization system autoclaves because of corrosion, damage, overfilling, or excessive size. A cylinder transfer

**TABLE 2.2-1 Summary of Portsmouth Conversion Facility Parameters**

| Parameter/Characteristic | Value |
|---|---|
| Construction start | 2004 |
| Construction period | 2 years |
| Start of operations | 2006 |
| Operational period | 18 years |
| Facility footprint | 10 acres (4 ha) |
| Facility throughput | 13,500 t/yr (15,000 tons/yr) $DUF_6$ (≈1,000 cylinders/yr) |
| Conversion products | |
| Depleted $U_3O_8$ | 10,800 t/yr (11,800 tons/yr) |
| $CaF_2$ | 18 t/yr (20 tons/yr) |
| 70% HF acid | 2,500 t/yr (2,800 tons/yr) |
| 49% HF acid | 5,800 t/yr (6,300 tons/yr) |
| Steel (emptied cylinders, if not used as disposal containers) | 1,177 t/yr (1,300 tons/yr) |
| Proposed conversion product disposition (see Table 2.2-2 for details) | |
| Depleted $U_3O_8$ | Disposal; Envirocare (primary), NTS (secondary)[a] |
| $CaF_2$ | Disposal; Envirocare (primary), NTS (secondary) |
| 70% HF acid | Sale pending DOE approval |
| 49% HF acid | Sale pending DOE approval |
| Steel (emptied cylinders, if not used as disposal containers) | Disposal; Envirocare (primary), NTS (secondary) |

[a] DOE plans to decide the specific disposal location(s) for the depleted $U_3O_8$ conversion product after additional appropriate NEPA review. Accordingly, DOE will continue to evaluate its disposal options and will consider any further information or comments relevant to that decision. DOE will give a minimum 45-day notice before making the specific disposal decision and will provide any supplemental NEPA analysis for public review and comment.

Sources: UDS (2003a,b).

system would be used to transfer the contents of up to four unacceptable cylinders per week to acceptable cylinders. Cylinder transfer system equipment would include two low-temperature autoclaves, four fill positions, a “hot box” containing controls and vacuum pumps, and an oversize cylinder heating room. Fill positions would include a water spray cooling system necessary for low-temperature $DUF_6$ transfer. The oversize cylinder heating room would contain radiant heating enclosure controls and connections.

### 2.2.2.2 Vaporization System

Cylinders that met the vaporization criteria would be brought to the vaporization room and loaded into electrically heated autoclaves. Autoclaves for each process line would be used to provide continuous feed to the $DUF_6$ conversion units. The cylinders would be heated to feed $DUF_6$ vapor to the process. The design will incorporate in-line filters to provide additional assurances that TRU isotopes would not enter the conversion system. The need for in-line filters would be evaluated during operations; they might be removed if they were not needed.

The $DUF_6$ vapor would flow through a heated enclosure called a "hot box," which contains the equipment that would control flow to the conversion units, including vacuum pumps. The hot box has the necessary controls to achieve stable $DUF_6$ flow to the conversion units.

The autoclaves would be used to heat $DUF_6$ cylinders by internal electrical heating and to provide secondary $DUF_6$ containment. The selected autoclaves would be American Society of Mechanical Engineers standard pressure vessels, sufficiently designed to provide containment of $DUF_6$ and HF from a full, $DUF_6$ cylinder that had ruptured. Each autoclave system would include equipment and controls to connect to the cylinder, control $DUF_6$ flow, monitor $DUF_6$ weight, and control vaporization conditions.

Electrically heated autoclaves would provide a safety advantage over steam-heated units. If $DUF_6$ leaks in a steam autoclave, the $DUF_6$ reacts with the steam and generates HF gas, which pressurizes the autoclave and is extremely corrosive. If $DUF_6$ leaks in an electrically heated autoclave, however, the only moisture available is humidity in the air, which limits HF generation and subsequent pressurization and corrosion. This also makes cleanup of the autoclave much easier since the autoclave is evacuated directly to the conversion unit and does not produce wet uranium recycle and liquid wastes.

### 2.2.2.3 Conversion System

$DUF_6$ vapor would be reacted with steam and hydrogen in fluidized-bed conversion units. The hydrogen would be generated by using anhydrous ammonia ($NH_3$). Nitrogen is also used as an inert purging gas and is released to the atmosphere through the building stack as part of the clean off-gas stream. The oxide powder would be retained in the conversion unit by passing the process off-gas through sintered metal filters. Uranium oxide powder would be continuously withdrawn from the conversion unit to match the feed rate of $DUF_6$. Each conversion unit would be electrically heated and integrated with a heating/insulation jacket.

All equipment components (vessels, filters, etc.) in the conversion system would be fabricated of corrosion-resistant alloys suited to process conditions. In the event of a system failure or an unscheduled shutdown, the $DUF_6$ shutoff valve in the autoclave would automatically close. The $DUF_6$ piping would then be purged with nitrogen. In the event of power, instrument, air, or other failure, a fail-safe design would be used for valves and for the control system.

#### 2.2.2.4 Depleted Uranium Conversion Product Handling System

Depleted $U_3O_8$ powder would be cooled as it was discharged from the conversion unit. An in-line water-cooled heat exchanger would cool the powder before it dropped into a vacuum transfer station enclosure. The vacuum transfer station would include connections, a vacuum transfer pickup device, a support vessel, a hopper, and a secondary enclosure to facilitate packaging the depleted $U_3O_8$. A package fill station would be located below each hopper. Powder fill would be controlled by weight in the fill container, and a secondary containment enclosure would be provided at the fill station. The filled packages would be lifted and conveyed by using an overhead monorail crane through an airlock and loaded into railcars for shipment to the disposal site. Each packaging station would operate on a semicontinuous basis with intermittent package removal and installation. Continuous level control would maintain the oxide hopper at 20% to 25% of capacity. Prior to package change out, the oxide discharge would be stopped.

UDS proposes to use the emptied cylinders as disposal containers to the extent practicable. An option of using bulk bags (large capacity, strong, flexible bags) as disposal containers is also being considered. After being processed (see Section 2.2.2.6), the emptied cylinders would be moved to the conversion product transfer station and refilled with depleted $U_3O_8$ powder. The refilled cylinders would be sealed and loaded to railcars for shipment to the disposal site. Bulk bags would be handled similarly.

The conversion facilities are being designed with a short-term storage capacity for 6 months' worth of depleted uranium conversion products. This storage capacity is being provided in order to accommodate potential delays in disposal activities without affecting conversion operations. If a delay was to extend beyond 6 months, DOE would evaluate possible options and conduct appropriate NEPA review for those options.

#### 2.2.2.5 HF Recovery System

The fluorine component of the $DUF_6$ would leave the conversion unit as HF gas through sintered metal filters that would retain nearly all (greater than 99.9%) of the uranium in the conversion unit. The HF would be condensed, along with the unreacted excess steam, and the resulting HF acid would flow by gravity to receiver tanks. In addition, the off-gas would be passed through a series of two scrubbers to recover most of the uncondensed HF. In each scrubber, process off-gas would come into contact with 20% potassium hydroxide (KOH) solution. HF vapor would combine with KOH in the solution to form potassium fluoride (KF) and water ($H_2O$); thus HF would be removed from the process off-gas stream.

The HF acid would be automatically transferred from the receivers to interim bulk storage tanks located outside the building. An in-line uranium analyzer in each transfer line would be used as a final verification that containment of the uranium was intact. High-integrity piping and equipment made with corrosion-resistant materials would result in zero leakage of HF, either gaseous or liquid, to the environment. The HF would be stored on site at each conversion facility for approximately 2 weeks or less under normal conditions and then shipped to a vendor. The storage capacity for HF at each site is limited, and if the material could not be moved, it would be converted to $CaF_2$ or processing would stop.

#### 2.2.2.6 Emptied Cylinder Processing

UDS proposes to use the emptied cylinders as disposal containers to the extent practicable. After removal of the cylinders from the autoclaves, a stabilizing agent would be introduced to the cylinders to neutralize residual fluoride in the heels. After an approximate 4-month aging period, emptied cylinders (with heel) would be transferred to the conversion product transfer stations, as described above. Alternatively, if bulk bags were used for depleted $U_3O_8$ disposal containers, after an approximate 4-month aging period, emptied cylinders (with heel) would be transported into the cylinder disposition facility. A forklift would be used to move the cylinders to the feed queue outside the facility airlock. Cylinders would then be brought into the disposition facility via an overhead monorail crane and placed into a compactor feed station. The plugs would be removed from the cylinder to vent the cylinder during crushing. The cylinder would then be pushed by a ram into the compactor itself, where it would be compacted radially to a maximum thickness of 8 in. (20 cm). The compacted cylinder would then be pushed to the cutting station, where it would be cut in half to reduce the length. The two pieces of metal would be picked up with an overhead crane and placed into an intermodal shipping container. Debris from these operations would then be collected in a container by a vacuum system and loaded into the intermodal container.

Secondary containment would be provided for the intermodal container loadout. In addition, small cylinders that had not been compacted, as well as valves, plugs, and facility secondary waste, might also be loaded into the intermodal containers. Cylinders that were destined for disposal at NTS would not be introduced into the facility but would instead be loaded directly onto trucks or railcars for transport.

#### 2.2.2.7 Management of Potential Transuranic and PCB Contamination

As discussed in Section 1.2.2, as a result of enrichment of reprocessed uranium in the early years of gaseous diffusion, some of the $DUF_6$ inventory is contaminated with small amounts of Tc and the TRU elements Pu, Np, and Am. In addition, a portion of the cylinder inventory was originally painted with coatings containing PCBs.

TRU contamination in the cylinders would exist as fluoride compounds that would be both insoluble in liquid $DUF_6$ and nonvolatile but capable of being entrained from the cylinders during the vaporization and feeding of $DUF_6$ into the conversion process. The TRU contamination would exist primarily as (1) small particulates dispersed throughout the $DUF_6$ contents and (2) small quantities in the residual heels from the original feed cylinders in a relatively small but unknown number of cylinders (see Appendix B for more details). Tc contamination would exist as fluoride and oxyfluoride compounds that would be stable and partially volatile, and the contamination would be present both uniformly dispersed throughout the $DUF_6$ and in the heel material referred to previously.

The TRU contaminants that are dispersed throughout the $DUF_6$ might be entrained in the gaseous $DUF_6$ during the cylinder emptying operations and carried out of the cylinders. These contaminants could be captured in filters between the cylinders and the conversion units. These filters would be monitored and changed out periodically to prevent buildup of TRU. They would be disposed of as LLW.

It is also expected that the nonvolatile forms of Tc that exist in the cylinders would remain in the heels or be captured in the filters. However, because of the existence of some volatile technetium fluoride compounds, and for the purposes of analyses in this EIS, it is assumed that all of the Tc dispersed in the $DUF_6$ would volatilize with $DUF_6$ and be carried into the conversion process equipment. Any Tc compounds transferred into the conversion units would be oxidized along with the $DUF_6$. For this EIS, it is also assumed that the Tc in the form of oxides would partition into the $U_3O_8$ and HF products in the same ratio as the uranium. It is assumed that Tc left in the heels from the original feedstock would remain behind after the $DUF_6$ was vaporized.

If bulk bags were used for depleted $U_3O_8$ disposal, the emptied cylinders would be processed as described in Section 2.2.2.6. The emptied cylinders would be surveyed by using nondestructive assay techniques to determine the presence of a significant quantity of TRU isotopes. If TRU isotopes were detected, samples would be taken and analyzed. Cylinders that exceeded the disposal site limits at the Envirocare of Utah, Inc., facility would be treated to immobilize the heel (e.g., with grout) within the cylinder, compacted, and sectioned; then the cylinder/heel waste stream would be sent to NTS and disposed of as LLW.

As noted in Section 1.2.2, the paints applied to some cylinders prior to 1978 included PCBs, which were typically added as a fungicide and to increase durability and flexibility. Records of the PCB concentrations in the paints used were not kept, so it is currently unknown how many cylinders are coated with paint containing PCBs. However, paint chips from a representative sample of cylinders at the ETTP site have been analyzed for PCBs. The results indicate that up to 50% of the cylinders at ETTP may have coatings containing PCBs. Because the Portsmouth and Paducah inventories contain a large number of cylinders produced before 1978, it is reasonable to assume that a significant number of cylinders at those sites also are coated with paint containing PCBs.

For each of the three storage sites, the PCBs in cylinder paints constitute an extremely small proportion of the PCBs that were previously and are currently at the sites. For example, although the Paducah site has been working for several years to dispose of PCB-containing equipment, the site still had about 870 liquid PCB-containing items (mostly capacitors) in service at the end of 2001. The Portsmouth and ETTP sites also still have a large number of liquid PCB-containing items in service. The three sites are suspected to have had spills of PCB liquids during past operations, prior to the identification of the health and environmental hazards of PCBs.

Each of the three current $DUF_6$ cylinder storage sites has an existing program for managing PCB-contaminated waste under the Toxic Substances Control Act (TSCA). In addition, the environmental monitoring program at each site includes monitoring of PCB concentrations in soil, sediment, groundwater, surface water, and biota on and in the vicinity of the sites (see Sections 3.1 and 3.2). These programs would be expected to continue throughout cylinder management activities.

Under the proposed action, storage, conversion, transportation, and disposal operations will comply with applicable TSCA regulations. Additional details are provided in Appendix B.

### 2.2.3 Conversion Product Disposition

The conversion process would generate four conversion products that have a potential use or reuse: depleted $U_3O_8$, HF, $CaF_2$, and steel from emptied $DUF_6$ cylinders (if not used as disposal containers). DOE has been working with industrial and academic researchers for several years to identify potential uses for these products. Some potential uses for depleted uranium exist or are being developed, and DOE believes that a viable market exists for the HF generated during conversion. To take advantage of these to the extent possible, DOE requested in the RFP that the bidders for conversion services investigate and propose viable uses. The probable disposition paths identified by UDS for each of the conversion products are summarized in Table 2.2-2 (UDS 2003b).

According to UDS, of the four conversion products, only HF has a viable commercial market currently interested in the product. Therefore, UDS expects that the HF would be sold to a commercial vendor pending DOE approval of the residual contamination limits and the sale. Commercial-grade HF produced at the Framatome ANP, Inc. (a UDS partner), facility in Richland, Washington, is currently sold commercially under an NRC-approved license. UDS is currently working with DOE through a formal process to evaluate and establish authorized release limits for the HF. Details on this process and on HF sale and use are provided in Appendix E. Should the release of the HF not be allowed, it would be neutralized to $CaF_2$ for sale or disposal, creating about 2 t (2.2 tons) per 1 t (1.1 ton) of HF. UDS will seek to obtain DOE approval to sell this material as well. However, the market is not as strong as that for the HF; thus, the $CaF_2$ produced during normal operations might become waste.

Although the depleted $U_3O_8$ and emptied cylinders have the potential for use or reuse, currently none of the uses have been shown to be viable because of cost, perception, feasibility, or the need for additional study. Thus, UDS expects that most, if not all, of the uranium oxide and emptied cylinders will require disposal. These materials would be processed and may be shipped to Envirocare for disposal, as summarized in Table 2.2-2.

The EIS evaluation of conversion product disposition considers:

- Transportation of the uranium oxide conversion product and emptied cylinders by truck and rail to both Envirocare (proposed) and NTS (option) for disposal. DOE plans to decide the specific disposal location(s) for the depleted $U_3O_8$ conversion product after additional appropriate NEPA review. Accordingly, DOE will continue to evaluate its disposal options and will consider any further information or comments relevant to that decision.

**TABLE 2.2-2 Summary of Proposed Conversion Product Treatment and Disposition**

| Conversion Product | Packaging/Storage | Proposed Disposition | Optional Disposition |
|---|---|---|---|
| Depleted $U_3O_8$ | $U_3O_8$ would be loaded into emptied cylinders, which would be loaded onto railcars. An option of using bulk bags as disposal containers is also considered. | Disposal at Envirocare of Utah, Inc.[a] | Disposal at NTS.[a] |
| $CaF_2$ | Packaged for sale or disposal. | Commercial sale pending DOE approval of authorized release limits, as appropriate. | Disposal at Envirocare of Utah, Inc.[a] |
| HF acid (49% and 70%) | HF produced by the dry conversion facility would be commercial grade. HF would be stored on site until loaded into rail tank cars. | Sale to commercial HF acid supplier pending DOE approval of authorized release limits, as appropriate. | Neutralization of HF to $CaF_2$ for use or disposal. |
| Steel (emptied cylinders) | Emptied cylinders would be reused as disposal containers for $U_3O_8$ to the extent practicable. If bulk bags were used, the emptied cylinders would have a stabilizing agent added to neutralize residual fluorine, be stored for 4 months, crushed to reduce the size, sectioned, and packaged in intermodal containers. | Disposal at Envirocare of Utah, Inc.[a] | Disposal at NTS.[a] |

[a] DOE plans to decide the specific disposal location(s) for the depleted $U_3O_8$ conversion product after additional appropriate NEPA review. Accordingly, DOE will continue to evaluate its disposal options and will consider any further information or comments relevant to that decision. DOE will give a minimum 45-day notice before making the specific disposal decision and will provide any supplemental NEPA analysis for public review and comment.

DOE will give a minimum 45-day notice before making the specific disposal decision and will provide any supplemental NEPA analysis for public review and comment.

- Transportation and sale of the HF conversion product, and

- Neutralization of HF to $CaF_2$ and its sale or disposal in the event that the HF product is not sold.

Because specific destinations are unknown at this time, impacts from the shipment of HF and $CaF_2$ for use are based on a range of representative route distances. Additional details concerning the transportation assessment are provided in Appendix F, Section F.3.

**Transportation Requirements for $DUF_6$ Cylinders**

All shipments of $UF_6$ cylinders have to be made in accordance with applicable DOT regulations for the shipment of radioactive materials; specifically, the provisions of 49 CFR Part 173, Subpart I. The DOT regulations require that each $UF_6$ cylinder be designed, fabricated, inspected, tested, and marked in accordance with the various engineering standards that were in effect at the time the cylinder was manufactured. The DOT requirements are intended to maintain the safety of shipments during both routine and accident conditions. The following provisions are particularly important relative to $DUF_6$ cylinder shipments:

1. A cylinder must be filled to less than 62% of the certified volumetric capacity (the fill limit was reduced to from 64% to 62% in about 1987).

2. The pressure within a cylinder must be less than 14.8 psia (subatmospheric pressure).

3. A cylinder must be free of cracks, excessive distortion, bent or broken valves or plugs, and broken or torn stiffening rings or skirts, and it must not have a shell thickness that has decreased below a specified minimum value. (Shell thicknesses are assessed visually by a code vessel inspector, and ultrasonic testing may be specified at the discretion of the inspector to verify wall thickness, when and in areas the inspector deems necessary.)

4. A cylinder must be designed so that it will withstand (1) a hydraulic test at an internal pressure of at least 1.4 megapascals (200 psi) without leakage; (2) a free drop test onto a flat, horizontal surface from a height of 1 ft (0.3 m) to 4 ft (1.2 m), depending on the cylinder's mass, without loss or dispersal; and (3) a 30-minute thermal test equivalent to being engulfed in a hydrocarbon fuel/air fire having an average temperature of at least 800°C (1,475°F) without rupture of the containment system.

### 2.2.4 Preparation and Transportation of ETTP Cylinders

DOE proposes to ship cylinders stored at ETTP to Portsmouth for conversion. This EIS evaluates the preparation of $DUF_6$ and non-$DUF_6$ cylinders at ETTP and the transportation of those cylinders to Portsmouth by several different methods, as described below.

All shipments of ETTP cylinders would have to be made consistent with DOT regulations for the shipment of radioactive materials as specified in Title 49 of the CFR (see text box and Chapter 6). The cylinders could be shipped by truck or rail.

The majority of $DUF_6$ cylinders were designed, built, tested, and certified to meet the DOT requirements. The DOT requirements are intended to maintain the safety of shipments during both routine and accident conditions. A summary of the applicable transportation regulations for shipment of $UF_6$ is provided in Chapter 6 of this EIS; a detailed discussion of pertinent transportation regulations is presented in Biwer et al. (2001). Cylinders meeting the DOT requirements could be loaded directly onto specially designed truck trailers or railcars for shipment. However, after several decades in storage, some cylinders have physically deteriorated such that they no longer meet the DOT requirements.

It is unknown exactly how many $DUF_6$ cylinders do not meet DOT transportation requirements. As discussed in Section 1.7, it is estimated that up to 1,700 cylinders are DOT compliant, with the remainder not meeting the DOT requirements. Problems are related to the following DOT requirements that must be satisfied before shipment: (1) documentation must be available showing that each cylinder was properly designed, fabricated, inspected, and tested prior to being filled; (2) cylinders must be filled to less than 62% of the maximum capacity; (3) the pressure within cylinders must be less than atmospheric pressure; (4) cylinders must not leak or be damaged so they are unsafe; and (5) cylinders must have a specified minimum wall thickness. Cylinders not meeting these requirements are referred to as “noncompliant.” Some cylinders might fail to meet more than one requirement.

Three options exist for shipping noncompliant cylinders (Biwer et al. 2001):

1. The $DUF_6$ contents could be transferred from noncompliant cylinders into new or compliant cylinders.

2. An exemption could be obtained from DOT that would allow the $DUF_6$ cylinder to be transported either “as is” or following repairs. The primary finding that DOT would have to make to justify granting an exemption is this: the proposed alternative would have to achieve a safety level that would be at least equal to the level required by the otherwise applicable regulation or, if the otherwise applicable regulation did not establish a required safety level, would be consistent with the public interest and adequately protect against the risks to life and property that are inherent when transporting hazardous materials in commerce.

3. Noncompliant cylinders could be shipped in a protective overpack. In this case, the shipper would have to obtain an exemption from DOT that would allow the existing cylinder, regardless of its condition, to be transported if it was placed in an overpack. The overpack would have to be specially designed. Furthermore, DOT would have to determine that, if the overpack was fabricated, inspected, and marked according to its design, the resulting packaging (including the cylinder and the overpack) would have a safety level at least equal to the level required for a new $UF_6$ cylinder.

Before shipment, each cylinder would be inspected to determine if it met DOT requirements. This inspection would include a record review to determine if the cylinder was overfilled; a visual inspection for damage or defects; a pressure check to determine if the cylinder was overpressurized; and an ultrasonic wall thickness measurement (based on a visual inspection, if necessary). If a cylinder passed the inspection, the appropriate documentation would be prepared, and the cylinder would be loaded directly for shipment. The preparation of compliant cylinders (cylinders that meet DOT requirements) would include inspection activities, unstacking, on-site transfer, and loading onto a truck trailer or railcar. The cylinders would be secured by using the appropriate tiedowns, and the shipment would be labeled in accordance with DOT requirements. Handling and support equipment and the procedures for on-site movement and for loading the cylinders would be of the same type currently used for cylinder management activities at the storage sites.

This EIS considers the three options for shipping noncompliant cylinders from ETTP. The information on these activities is based on preconceptual design data provided in the Engineering Analysis Report (Dubrin et al. 1997) prepared for the $DUF_6$ PEIS and the analysis of potential environmental impacts presented in Appendix E of the $DUF_6$ PEIS (DOE 1999a).

An overpack is a container into which a cylinder is placed for shipment. The overpack would be designed, tested, and certified to meet all DOT shipping requirements. It would be suitable for containing, transporting, and storing the cylinder contents regardless of cylinder condition. For transportation, a noncompliant cylinder would be placed into an overpack that was already on a truck trailer or railcar. The overpack would be closed and secured, and the shipment would be labeled in accordance with DOT requirements. The overpacks could be reused following shipment.

The second cylinder preparation option for transporting noncompliant cylinders considered in this EIS is the transfer of the $DUF_6$ from substandard cylinders to new or used cylinders that would meet all DOT requirements. This option could require the construction of a new cylinder transfer facility, for which there are no current plans. Following transfer of the $DUF_6$, the compliant cylinders could be shipped by placing them directly onto appropriate trucks or railcars. If a decision were made to construct a transfer facility at ETTP, additional NEPA review would be conducted.

The third option is to ship the cylinders "as-is" under a DOT exemption. As discussed above, for this to occur, it must be demonstrated that the cylinders would be shipped in a manner achieving a level of safety that would be at least equal to the level required by the regulations, which would likely require some compensatory measures.

In this EIS, transportation impacts are estimated for shipment by either truck or rail after cylinder preparation. The impacts are assessed by determining truck and rail routes between ETTP and the Portsmouth site.

### 2.2.5 Construction of a New Cylinder Storage Yard at Portsmouth

It might be necessary to construct an additional yard at Portsmouth for storing the ETTP cylinders, depending on when and at what rate the ETTP cylinders were shipped. DOE is currently in the process of determining if a new yard is required, or if existing storage yard space could be used for the ETTP cylinders. The potential environmental impacts from the construction of a new cylinder storage yard have been included in this EIS to account for current uncertainties.

Two possible locations for new cylinder yard construction were identified at the Portsmouth site, as shown in Figure 2.2-4 (also identified in Figure 2.2-4 is an existing concrete pad being evaluated for temporary storage of the ETTP cylinders). Both areas are adjacent to current DOE cylinder storage yards. Proposed Area 1 consists of three smaller sections with a total area of about 5.5 acres (2.2 ha). Proposed Area 2 consists of two smaller sections with a total area of about 6.3 acres (2.5 ha). New yards would be constructed of concrete and would be similar to other concrete yards constructed at the Portsmouth site. Potential environmental impacts from construction of a new yard at both locations identified are evaluated in this EIS.

### 2.2.6 Option of Shipping ETTP Cylinders to Paducah

As discussed above, DOE proposes to ship the $DUF_6$ and non-$DUF_6$ cylinders at ETTP to Portsmouth. However, this EIS considers shipping the ETTP cylinders to Paducah as an option. If the ETTP cylinders were shipped to Paducah, the Portsmouth conversion facility would have to operate for 14 rather than 18 years to convert the Portsmouth inventory. In Chapter 5, this EIS presents a discussion of the potential environmental impacts associated with this reduction in the operational period. Potential impacts associated with transportation of the ETTP cylinders to Paducah are evaluated in detail in the site-specific Paducah conversion facility EIS (DOE 2004a).

### 2.2.7 Option of Expanding Conversion Facility Operations

The conversion facility at Portsmouth is currently being designed to process the DOE $DUF_6$ cylinder inventory at the site over 18 years by using three process lines. There are no current plans to operate the conversion facility beyond this time period or to increase the throughput of the facility by adding a fourth process line. However, a future decision to extend conversion facility operations or increase throughput at the site could be made for several reasons. Consequently, this EIS includes an evaluation of the environmental impacts associated with expanding conversion facility operations at the site (either by increasing throughput or by extending operations beyond 18 years) in order to provide future planning flexibility (impacts are presented in Section 5.2.8). The possible reasons for expanding operations in the future are discussed below.

The DOE Office of Inspector General (OIG) issued a final audit report in March 2004 recommending that EM conduct a cost benefit analysis to determine the optimum size of the Portsmouth conversion facility and, on the basis of the results of that review, implement the most cost-effective approach (DOE 2004c). The report states that by adding an additional process line to the Portsmouth facility, the time to process the Portsmouth and ETTP inventories of $DUF_6$ could be shortened by 5 years at a substantial cost savings of 55 million dollars.

As stated in the DOE EM response to the OIG report (DOE 2004b), DOE is not planning to increase the number of process lines within the Portsmouth conversion facility in response to the OIG recommendations. Instead, on the basis of experience with other projects, DOE believes that higher throughput rates can be achieved by improving the efficiency of the planned equipment (DOE 2004b). The conversion contract provides significant incentives to the conversion contractor to improve efficiency. For example, the current facility designs are based on an assumption that the conversion plant would have an 84% on-line availability (percent of time system is on line and operational). However, Framatome's experience at the Richland plant indicates that the on-line availability is expected to be at least 90%. Therefore, there is additional capacity expected to be realized in the current design. Although there are no plans to increase the throughput at the Portsmouth facility by adding an additional process line, as recommended by the OIG, the potential environmental impacts associated with increasing the plant throughput, by both process improvements and the addition of a fourth process line, are discussed in Section 5.2.8 of this EIS.

A future decision to extend operations or expand throughput might also result from the fact that DOE could assume management responsibility for $DUF_6$ in addition to the current inventory. Two statutory provisions make this possible. First, Sections 161v. [42 USC 2201(v)] and 1311 [42 USC 2297b-10] of the AEA of 1954 [P.L. 83-703], as amended, provide that DOE may supply services in support of USEC. In the past, these provisions were used once to transfer $DUF_6$ cylinders from USEC to DOE for disposition in accordance with DOE orders, regulations, and policies. Second, Section 3113(a) of the USEC Privatization Act [42 USC 2297h-11(a)] requires DOE to accept LLW, including depleted uranium that has been determined to be LLW, for disposal upon request and reimbursement of costs by USEC or any other person licensed by the NRC to operate a uranium enrichment facility. This provision has not been invoked, and the form in which depleted uranium would be transferred to DOE by a uranium enrichment facility invoking this provision is not specified. However, DOE believes depleted uranium transferred under this provision in the future would most likely be in the form of $DUF_6$, thus adding to the inventory of material needing conversion at the $DUF_6$ conversion facilities and disposition.

Several possible sources of additional $DUF_6$ generated from uranium enrichment activities include the following:

1. USEC continues to operate the gaseous diffusion plant at the Paducah site, generating approximately 1,000 cylinders per year of $DUF_6$. In the past, DOE signed MOAs with USEC transferring $DUF_6$ cylinders to DOE (DOE and USEC 1998a,b); the latest was signed in June 2002 for $DUF_6$ generated from 2002 through 2005. Future MOAs are possible. Consequently, DOE may assume responsibility for additional $DUF_6$ cylinders at the Paducah site.

2. USEC is currently in the process of developing and demonstrating an advanced enrichment technology based on gas centrifuges. A license for a lead test facility to be operated at the Portsmouth site was issued by the NRC in February 2004. In January 2004, USEC announced that its future enrichment facility using the advanced technology would be sited at the Portsmouth site. Consequently, additional $DUF_6$ could be generated at this site that ultimately could be transferred to DOE.

3. New commercial uranium enrichment facilities may be built and operated in the United States by commercial companies other than USEC. Although there are no agreements for DOE to accept $DUF_6$ from such commercial sources, it is possible in the future.

If DOE took responsibility for additional $DUF_6$ in the future, it is reasonable to assume that the conversion facilities at Portsmouth and/or Paducah could be operated longer than specified in the current plans in order to convert this material or that the throughput of the facilities could be increased. The duration of extended operations or the size of a throughput increase would depend on the quantity of material transferred and the location of the transfer.

In addition, because, under the current plans, the Portsmouth facility could conclude operations approximately 7 years before the current Paducah inventory would be converted at the Paducah site, it is possible that $DUF_6$ cylinders could be transferred from Paducah to Portsmouth to facilitate conversion of the entire inventory, particularly if DOE assumed responsibility for additional $DUF_6$ at Paducah.

The potential environmental impacts associated with extended plant operations, increased facility throughput, and Paducah-to-Portsmouth cylinder shipments are discussed in Section 5.2.8.

## 2.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

### 2.3.1 Utilization of Commercial Conversion Capacity

During the scoping process for the PEIS, it was suggested that DOE consider using existing $UF_6$ conversion capacity at commercial nuclear fuel fabrication facilities that convert natural or enriched $UF_6$ to $UO_2$ in lieu of constructing new conversion capacity for $DUF_6$. Accordingly, in May 2001, DOE investigated the capabilities of existing commercial nuclear fuel fabrication facilities in the United States to determine whether this suggested approach would be a reasonable alternative. Publicly available information was reviewed, and an informal telephone survey of U.S. commercial fuel cycle facilities was conducted. The investigation report concluded that if 100% of the $UF_6$ conversion capacity of domestic commercial nuclear fuel fabrication facilities operating in May 2001 could be devoted to converting DOE's $DUF_6$ inventory, approximately 5,500 t (6,100 tons) of $DUF_6$ could be converted per year. On the basis of this conclusion, the investigation report estimated that it would take more than 125 years to convert DOE's $DUF_6$ inventory by using only existing conversion capacity. Furthermore, during the informal telephone survey, U.S. commercial fuel fabrication facilities were willing to confirm a capacity of only about 300 t (331 tons) of $UF_6$ per year as being possibly available to DOE. The investigation report indicated that there seems to be a general lack of interest on the part of the facility owners in committing existing operating or mothballed capacity to conversion of the DOE $DUF_6$ inventory (Ranek and Monette 2001).

Even though $UF_6$ conversion capacity at commercial nuclear fuel fabrication facilities might become available in the future, the small capacity identified in 2001 as being possibly available to DOE, coupled with the low interest level expressed at that time by facility owners, indicates that the feasibility of this suggested alternative is low. Therefore, this EIS does not analyze in detail the alternative of using existing capacity at commercial nuclear fuel fabrication facilities.

### 2.3.2 Other Sites

The consideration of alternative sites was limited to alternative locations within the Portsmouth site in response to Congressional direction. As discussed in detail in Section 1.1, Congress has acted twice regarding the construction and operation of $DUF_6$ conversion plants at Portsmouth and Paducah.

First, in July 1998, P.L. 105-204 directed DOE to make a plan consistent with NEPA for the construction and operation of conversion facilities at Portsmouth and Paducah. Consequently, DOE prepared a plan (DOE 1999b) and published an NOI in the *Federal Register* on September 18, 2001 (68 FR 48123) that identified the range of alternatives to be considered in a conversion facility EIS, including the alternative of constructing only one conversion plant.

Second, while the preparation of the conversion facility EIS was underway, Congress acted again regarding $DUF_6$ management by passing P.L. 107-206 in August 2002. The pertinent part of P.L. 107-206 directed DOE to award a contract for construction and operation of conversion facilities at the Portsmouth and Paducah sites and to commence construction no later than July 31, 2004. Subsequently, DOE reevaluated the appropriate approach of the NEPA review and decided to prepare two separate site-specific EISs. This change was announced in the *Federal Register* on April 28, 2003 (68 FR 22368). Consistent with the direction of P.L. 107-206, the alternatives for placing the conversion facilities were limited in each site-specific EIS to locations within the Portsmouth and Paducah sites, respectively.

### 2.3.3 Other Conversion Technologies

This EIS provides a detailed analysis of impacts associated with the proposed UDS conversion of $DUF_6$ to depleted $U_3O_8$. As discussed in Section 1.6.2.2, the conversion project RFP did not specify the conversion product technology or form. Three proposals submitted in response to the RFP were deemed to be in the competitive range; two of these proposals involved conversion of $DUF_6$ to $U_3O_8$ and the third involved conversion to depleted $UF_4$. Potential environmental impacts associated with these proposals were considered during the procurement process, including the preparation of an environmental critique and environmental synopsis, which were prepared in accordance with the requirements of 10 CFR 1021.216.

The environmental synopsis is presented in Appendix D. The environmental synopsis concluded that, on the basis of the assessment of potential environmental impacts presented in the critique, no proposal was clearly environmentally preferable. Although differences in a number of impact areas were identified, none of the differences were considered to result in one proposal being preferable over the others. In addition, the potential environmental impacts associated with the proposals were found to be similar to, and generally less than, those presented in the $DUF_6$ PEIS (DOE 1999a) for representative conversion technologies.

### 2.3.4 Long-Term Storage and Disposal Alternatives

This EIS considers the site-specific impacts from conversion operations at the Portsmouth site, impacts from the transportation of depleted uranium conversion products to NTS and Envirocare for disposal, and impacts from the potential sale of HF and $CaF_2$ produced from conversion. Environmental impacts are not explicitly evaluated for the long-term storage of conversion products or for disposal.

At this time, there are no specific proposals for the long-term storage of conversion products that would warrant more detailed analysis. Long-term storage alternatives were analyzed in the PEIS, including storage as $DUF_6$ and storage as an oxide (either $U_3O_8$ or $UO_2$). For long-term storage of $DUF_6$, the options considered were storage in outdoor yards, buildings, and an underground mine. For long-term storage as an oxide, storage in buildings, underground vaults, and an underground mine were considered. The potential environmental impacts from long-term storage were evaluated for representative and generic sites. Preconceptual designs presented in the Engineering Analysis Report (Dubrin et al. 1997) were used as the basis for the analysis, and the evaluation of environmental impacts considered a 40-year period.

This EIS evaluates the impacts from packaging, handling, and transporting conversion products from the conversion facilities to a LLW disposal facility. The disposal facility would be (1) selected in a manner consistent with DOE policies and orders and (2) authorized or licensed to receive the conversion products by either DOE (in conformance with DOE orders), the NRC (in conformance with NRC regulations), or an NRC Agreement State agency (in conformance with state laws and regulations determined to be equivalent to NRC regulations). Assessment of the impacts and risks from on-site handling and disposal at the LLW disposal facility is deferred to the disposal site's site-specific NEPA or licensing documents. However, this EIS covers the impacts from transporting the $DUF_6$ conversion products to both Envirocare and NTS.

### 2.3.5 Other Transportation Modes

Transportation by air and barge were considered but not analyzed in detail. Transportation by air was deemed to not be reasonable for the types and quantities of materials that would be transported to and from the conversion site. Any transportation by air would involve only small quantities of specialty materials or items generally carried through mail delivery services.

Transportation by barge was also considered, but although it could be used to ship cylinders among the three current storage sites, it was not evaluated in detail. As explained more fully in Section 4.1 of the Engineering Analysis Report (Dubrin et al. 1997), ETTP is the only site with a nearby barge facility. Portsmouth would either have to build new facilities or use existing facilities that are located 20 to 30 mi (32 to 48 km) from the Portsmouth site. Use of existing facilities would require on-land transport by truck or rail over the 20- to 30-mi (32- to 48-km) distance, and the cylinders would have to go through one extra unloading/loading step at the end of the barge transport. Currently, there are no initiatives to build new barge facilities closer to the Portsmouth site. If barge shipment was proposed in the future and considered to be a reasonable option, additional NEPA review would be conducted.

### 2.3.6 One Conversion Plant Alternative

In the NOI published in the *Federal Register* on September 18, 2001, construction and operation of one conversion plant was identified as a preliminary alternative that would be considered in the conversion EIS. However, with the passage of P.L. 107-206, which mandates the award of a contract for the construction and operation of conversion facilities at both Paducah and Portsmouth, the one conversion plant alternative was considered but not analyzed in this EIS.

## 2.4 COMPARISON OF ALTERNATIVES

### 2.4.1 General

This EIS includes analyses of a no action alternative and the proposed action of building and operating a conversion facility at three alternative locations within the Portsmouth site. Listed below is a general comparison of the activities required for each alternative and the types of environmental impacts that could be expected from each. A detailed comparison of the estimated environmental impacts associated with the alternatives is provided in Section 2.4.2.

- The no action alternative would consist of the continued surveillance and maintenance of the $DUF_6$ inventories at the Portsmouth and ETTP sites. No conversion facility would be constructed or operated. Only minor yard reconstruction would be required, and no cylinders would be shipped off site. Cylinder breaches could occur as a result of damage during handling or external corrosion.

  Potential environmental impacts associated with the no action alternative would be primarily limited to (1) the exposure of involved workers to external radiation in the cylinder yards during surveillance and maintenance activities, (2) impacts associated with the possible release of depleted uranium and HF from breached cylinders and their dispersal in the environment (before the breaches were identified and repaired), and (3) potential accidents that could damage cylinders and result in a release of $DUF_6$.

- The proposed action would involve the construction and operation of a conversion facility at Portsmouth. Three alternative locations are considered. It would take the conversion facility approximately 18 years to convert the entire $DUF_6$ inventory to $U_3O_8$ at a rate of approximately 1,000 cylinders (13,500 t [15,000 tons]) per year. This includes conversion of about 4,800 $DUF_6$ cylinders to be transported from the ETTP site. Shipping of about

1,100 non-$DUF_6$ cylinders from ETTP to Portsmouth is also included; however, conversion of the contents of these cylinders is not included under the proposed action. Finally, aqueous HF could also be produced for sale during the conversion process, or the HF could be neutralized to $CaF_2$ for sale or disposal.

The proposed action also evaluates construction of a new cylinder storage yard at Portsmouth for the ETTP cylinders, if required. Two alternate areas for the storage yard are considered (see Figure 2.2-4).

The option of shipping approximately 5,900 cylinders (approximately 4,800 $DUF_6$ cylinders for conversion and about 1,100 non-$DUF_6$ cylinders) from ETTP to Paducah rather than to Portsmouth is also evaluated. This option would reduce the period of operation of the Portsmouth conversion facility from 18 to 14 years.

After conversion, the conversion products ($U_3O_8$, aqueous HF or $CaF_2$, and emptied cylinders, if not used as disposal containers for $U_3O_8$) would be shipped by truck or rail to a user or disposal facility (either NTS or Envirocare).

Potential environmental impacts associated with the proposed action alternatives would include (1) impacts to local air, water, soil, ecological, and cultural resources during storage yard and facility construction; (2) impacts to workers from conversion facility construction and operations; (3) impacts from small amounts of depleted uranium and other hazardous compounds released to the environment through normal conversion plant air effluents; (4) impacts from the shipment of cylinders, conversion products, and waste products; and (5) impacts from potential accidents involving the release of radioactive material or hazardous chemicals.

### 2.4.2 Summary and Comparison of Potential Environmental Impacts

This EIS includes analyses of potential impacts at the Portsmouth and ETTP sites under the no action alternative and potential impacts at Portsmouth under the proposed action alternatives. Under the no action alternative, potential impacts associated with the continued storage of $DUF_6$ cylinders in yards are evaluated through 2039; in addition, the long-term impacts that could result from releases of $DUF_6$ and HF from future cylinder breaches are evaluated. For the proposed action, potential impacts are evaluated at three alternative locations for the following:

- The conversion facility construction period of approximately 2 years;

- Construction of a new cylinder storage yard over a period of about 3 months, if necessary;

- The operational period required to convert the entire $DUF_6$ inventory, which would equal 18 years (14 years if the ETTP inventory was shipped to Paducah instead); and

- A facility D&D period of 3 years.

Under each alternative, potential consequences are evaluated in many areas: human health and safety (during normal operations, accidents, and transportation), air quality, noise, water, soil, socioeconomics, ecology, waste management, resource requirements, land use, cultural resources, and environmental justice. (Methodologies are discussed in Chapter 4 and Appendix F.) The assessment considers impacts that could result from the construction of necessary facilities, normal operations of facilities, accidents, preparation of cylinders for shipment, transportation of materials, and the D&D of facilities after conversion is complete. In addition, the production and sale of aqueous HF is evaluated, as is the possibility of neutralizing HF to $CaF_2$ for sale or disposal.

The potential environmental impacts at Portsmouth under the proposed action alternatives and at Portsmouth and ETTP under the no action alternative are presented in Table 2.4-1 (placed at the end of this chapter). To supplement the information in Table 2.4-1, each area of impact evaluated in the EIS is discussed below. Major similarities and differences among the alternatives are highlighted. This section provides a summary comparison; additional details and discussion are provided in Chapter 5 for each alternative and area of impact.

#### 2.4.2.1 Human Health and Safety — Construction and Normal Facility Operations

Under the no action alternative and the action alternatives, it is estimated that potential exposures of workers and members of the public to radiation and chemicals would be well within applicable public health standards and regulations during normal facility operations (including 10 CFR 835, 40 CFR 61 Subpart H, and DOE Order 5400.5). The estimated doses and risks from radiation and/or chemical exposures of the general public and noninvolved workers would be very low, with zero latent cancer fatalities (LCFs) expected among these groups over the time periods considered, and with no adverse health impacts from chemical exposures expected. (Dose and risk estimates are shown in Table 2.4-1.) In general, the location of a conversion facility within the Portsmouth site would not significantly affect potential impacts to workers or the public during normal facility operations (i.e., no significant differences in impacts were identified at alternative Locations A, B, or C).

Involved workers (persons directly involved in the handling of radioactive or hazardous materials) could be exposed to low-level radiation emitted by uranium during the normal course of their work activities, and this exposure could result in a slight increase in the risk for radiation-induced LCFs to individual involved workers. (The possible presence of TRU and Tc contamination in the cylinder inventory would not contribute to exposures during normal operations.) The annual number of workers exposed could range from about 33 (under the no action alternative for Portsmouth and ETTP combined) to 163 under the action alternatives. Under all alternatives, it is estimated that radiation exposure of involved workers would be unlikely to result in additional LCFs among the entire involved worker populations (risks from radiation exposure range from a 1-in-10 chance of one additional LCF among the entire conversion facility involved worker population over the life of the project to a 1-in-5 chance of one additional LCF among the involved cylinder maintenance workers at Portsmouth under the no action alternative).

Possible radiological exposures from using groundwater potentially contaminated as a result of releases from breached cylinders or facility releases were also evaluated. In general, these exposures would be within applicable public health standards and regulations. However, the uranium concentration in groundwater could exceed 20 μg/L (the drinking water guideline used for comparison in this EIS) at some time in the future under the no action alternative if cylinder corrosion was not controlled. This scenario is highly unlikely because ongoing cylinder inspections and maintenance would prevent significant releases from occurring.

### 2.4.2.2 Human Health and Safety — Facility Accidents

**2.4.2.2.1 Physical Hazards.** Under all alternatives, workers could be injured or killed as a result of on-the-job accidents unrelated to radiation or chemical exposure. On the basis of accident statistics for similar industries, it is estimated that under the no action alternative, zero fatalities and about 70 injuries might occur through 2039 at the Portsmouth and ETTP sites (about 1 injury per year at Portsmouth, and about 0.7 injury per year at ETTP). Under the action alternatives, the risk of physical hazards would not depend on the location of the conversion facility. No fatalities are predicted, but about 11 injuries during conversion facility construction and up to 142 injuries during operations could occur at the conversion facility (about 6 injuries per year during construction and about 8 injuries per year during operations). In addition, 1 injury would be expected from construction of a new cylinder yard for ETTP cylinders. Accidental injuries and deaths are not unusual in industries that use heavy equipment to manipulate weighty objects and bulk materials.

**2.4.2.2.2 Facility Accidents Involving Radiation or Chemical Releases.** Under all alternatives, it is possible that accidents could release radiation or chemicals to the environment, potentially affecting both the workers and members of the public. Of all the accidents considered, those involving $DUF_6$ cylinders and those involving chemicals at the conversion facility would have the largest potential effects.

The $DUF_6$ Management Plan (DOE 1996e) outlines required cylinder maintenance activities and procedures to be undertaken in the event of a cylinder breach and/or release of $DUF_6$ from one or more cylinders. Under all alternatives, there is a low probability that accidents involving $DUF_6$ cylinders could occur at the current storage locations. If an accident occurred, $DUF_6$ could be released to the environment. The $DUF_6$ would combine with moisture in the air, forming gaseous HF and $UO_2F_2$, a soluble solid in the form of small particles. The depleted uranium and HF could be dispersed downwind, potentially exposing workers and members of the general public to radiation and chemical effects. The amount released would depend on the severity of the accident and the number of cylinders involved. The probability of cylinder accidents would decrease under the action alternatives as the $DUF_6$ was converted and the number of cylinders in storage decreased as a result.

For releases involving $DUF_6$ and other uranium compounds, both chemical and radiological effects could occur if the material was ingested or inhaled. The chemical effect of most concern associated with internal uranium exposure is kidney damage, and the radiological effect of concern is an increase in the probability of developing cancer. With regard to uranium, chemical effects occur at lower exposure levels than do radiological effects. Exposure to HF from accidental releases could result in a range of health effects, from eye and respiratory irritation to death, depending on the exposure level. Large anhydrous $NH_3$ releases could also cause severe respiratory irritation and death. ($NH_3$ is used to generate hydrogen, which is required for the conversion process.)

Chemical and radiological exposures to involved workers (those within 100 m [329 ft] of the release) under accident conditions would depend on how rapidly the accident developed, the exact location and response of the workers, the direction and amount of the release, the physical forces causing or caused by the accident, meteorological conditions, and the characteristics of the room or building if the accident occurred indoors. Impacts to involved workers under accident conditions would likely be dominated by physical forces from the accident itself; thus quantitative dose/effect estimates would not be meaningful. For these reasons, the impacts to involved workers during accidents are not quantified in this EIS. However, it is recognized that injuries and fatalities among involved workers would be possible if an accident did occur.

Under the no action alternative, for accidents involving cylinders that might happen at least once in 100 years (i.e., likely accidents [see Section 5.1.2.1.2]), it is estimated that the off-site concentrations of HF and uranium would be considerably below levels that would cause adverse chemical effects among members of the general public from exposure to these chemicals. However, up to 70 noninvolved workers might experience potential adverse effects from exposure to HF and uranium (mild and temporary effects, such as respiratory irritation or temporary decrease in kidney function). It is estimated that up to 3 noninvolved workers would experience potential irreversible adverse effects that are permanent in nature (such as lung damage or kidney damage); no fatalities are expected. Radiation exposures would be unlikely to result in additional LCFs among noninvolved workers or members of the general public for these types of accidents.

Cylinder accidents that are less likely to occur could be more severe, having greater consequences that could potentially affect off-site members of the general public. These types of accidents are considered extremely unlikely, expected to occur with a frequency of between once in 10,000 years and once in 1 million years of operations. Based on the expected frequency, through 2039, the probability of this type of accident was estimated to be about 1 chance in 2,500. Among all the cylinder accidents analyzed, the postulated accident that would result in the largest number of people with adverse effects (including mild and temporary as well as permanent effects) would be an accident that involves rupture of cylinders in a fire. If this type of accident occurred at the Portsmouth site, it is estimated that up to 680 members of the general public and up to 1,000 noninvolved workers might experience adverse chemical effects from HF and uranium exposure (mild and temporary effects, such as respiratory irritation or temporary decrease in kidney function).

The postulated cylinder accident that would result in the largest number of persons with irreversible adverse health effects is a corroded cylinder spill under wet conditions, with an estimated frequency of between once in 10,000 years and once in 1 million years of operations. If this accident occurred, it is estimated that 1 member of the general public and up to 140 noninvolved workers might experience irreversible adverse effects (such as lung damage or kidney damage). No fatalities are expected among members of the general public; there would be a potential for 1 fatality among noninvolved workers from chemical effects. Radiation exposures would be unlikely to result in additional LCFs among noninvolved workers (1 chance in 100) or the general public (1 chance in 30).

In addition to the cylinder accidents discussed above is a certain class of accidents that the DOE investigated; however, because of security concerns, information about such accidents is not available for public review but is presented in a classified appendix to the EIS. All classified information will be presented to state and local officials, as appropriate.

The number of persons actually experiencing adverse or irreversible adverse effects from cylinder accidents would likely be considerably fewer than those estimated for this analysis and would depend on the actual circumstances of the accident and the individual chemical sensitivities of the affected persons. For example, although exposures to releases from cylinder accidents could be life-threatening (especially with respect to immediate effects from inhalation of HF at high concentrations), the guideline exposure level of 20 parts per million (ppm) of HF used to estimate the potential for irreversible adverse effects from HF exposure is likely to result in overestimates. This is because no animal or human deaths have been known to occur as a result of acute exposures (i.e., 1 hour or less) at concentrations of less than 50 ppm; generally, if death does not occur quickly after HF exposure, recovery is complete.

Similarly, the guideline intake level of 30 mg used to estimate the potential for irreversible adverse effects from the intake of uranium in this EIS is the level suggested in NRC guidance. This level is somewhat conservative; that is, it is intended to overestimate rather than underestimate the potential number of irreversible adverse effects in the exposed population following uranium exposure. In more than 40 years of cylinder handling activities, no accidents involving releases from cylinders containing *solid* $UF_6$ have occurred that have caused diagnosable irreversible adverse effects among workers. In previous accidental exposure incidents involving *liquid* $UF_6$ in gaseous diffusion plants, some worker fatalities occurred immediately after the accident as a result of inhalation of HF generated from the $UF_6$. However, no fatalities occurred as a result of the toxicity of the uranium exposure. A few workers were exposed to amounts of uranium estimated to be about three times the guideline level (30 mg) used for assessing irreversible adverse effects; none of these workers, however, actually experienced such effects.

Under the action alternatives, low-probability accidents involving chemicals at the conversion facility could have large potential consequences for noninvolved workers and members of the public. At a conversion site, accidents involving chemical releases, such as $NH_3$

and HF, could occur. $NH_3$ is used to generate hydrogen for conversion, and HF can be produced as a co-product of converting $DUF_6$. Although the UDS proposal uses $NH_3$ to produce hydrogen, hydrogen can also be produced by using natural gas. In that case, the accident impacts would be much less than those discussed in this section for $NH_3$ accidents. (Details about potential $NH_3$ and other accidents are in Section 5.2.3.2 [conversion facility] and Section 5.2.5 [transportation].)

The conversion accident estimated to have the largest potential consequences is an accident involving the rupture of tanks containing either 70% HF or anhydrous $NH_3$. Such an accident could be caused by a large earthquake and is expected to occur with a frequency of less than once in 1 million years of operations. The probability of this type of accident occurring during the operation of a conversion facility is a function of the period of operation; over 18 years of operations, the accident probability would be less than 1 chance in 56,000.

If an aqueous HF or anhydrous $NH_3$ tank ruptured at the conversion facility, a maximum of up to about 2,300 members of the general public might experience adverse effects (mild and temporary effects, such as respiratory irritation or temporary decrease in kidney function) as a result of chemical exposure. A maximum of about 210 people might experience irreversible adverse effects (such as lung damage or kidney damage), with the potential for about 4 fatalities. With regard to noninvolved workers, up to about 1,400 workers might experience adverse effects (mild and temporary) as a result of chemical exposures. A maximum of about 1,400 noninvolved workers might experience irreversible adverse effects, with the potential for about 30 fatalities.

The location of the conversion facility within the Portsmouth site would affect the number of noninvolved workers and members of the general public who might experience adverse or irreversible adverse effects from an HF or anhydrous $NH_3$ tank rupture accident. However, the differences among the locations within each site would generally be small and within the uncertainties associated with the exact accident sequence and weather conditions at the time of the accident. An exception would be that the number of noninvolved workers impacted would be higher for Location B for both potential adverse and irreversible adverse effects.

Although such high-consequence accidents at a conversion facility are possible, they are expected to be extremely rare. The risk (defined as consequence × probability) for these accidents would be less than 1 fatality and less than 1 irreversible adverse health effect for noninvolved workers and members of the public combined. $NH_3$ and HF are commonly used for industrial applications in the United States, and there are well-established accident prevention and mitigative measures for HF and $NH_3$ storage tanks. These include storage tank siting principles, design recommendations, spill detection measures, and containment measures. These measures would be implemented, as appropriate.

Under the action alternatives, the highest consequence radiological accident is estimated to be an earthquake damaging the depleted $U_3O_8$ product storage building. If this accident occurred, it is estimated that about 135 lb (61 kg) of depleted $U_3O_8$ would be released to the atmosphere outside of the building. The maximum collective dose received by the general public and the noninvolved workers would be about 30 person-rem and 530 person-rem, respectively.

There would be about a 1-in-50 chance of an LCF among the public and a 1-in-5 chance of an LCF among the noninvolved workers. Because the accident has a probability of occurrence that is about 1 chance in 6,000, the risk posed by the accident would be essentially zero LCFs among both the public and the workers.

#### 2.4.2.3 Human Health and Safety — Transportation

Under the no action alternative, only small amounts of the LLW and low-level radioactive mixed waste (LLMW) that would be generated during routine cylinder maintenance activities would require transportation (about one shipment per year). Only negligible impacts are expected from such shipments. No $DUF_6$ or non-$DUF_6$ cylinders would be transported between sites.

Under the action alternatives, the total number of shipments would include the following:

1. If $U_3O_8$ was disposed of in emptied cylinders, there would be approximately 4,200 railcar shipments of depleted $U_3O_8$ from the conversion facility to Envirocare (proposed) or NTS (option), or up to 21,000 truck shipments (alternative) to either Envirocare or NTS. The numbers of shipments would be about 8,800 for truck and 2,200 for railcar if bulk bags were used as disposal containers.

2. About 8,200 truck or 1,640 railcar shipments of aqueous (70% and 49%) HF could occur; alternatively, the aqueous HF could be neutralized to $CaF_2$, requiring a total of about 13,600 truck or 3,400 railcar shipments. Currently, the destination for these shipments is not known.

3. About 700 truck or 350 railcar shipments of anhydrous $NH_3$ from a supplier to the site. Currently, the origin of these shipments is not known.

4. Emptied heel cylinders to Envirocare or NTS, if bulk bags were used to dispose of the depleted $U_3O_8$.

5. Approximately 5,400 truck or 1,400 railcar shipments of cylinders from ETTP to Portsmouth.

During normal transportation operations, radioactive material and chemicals would be contained within their transport packages. Health impacts to crew members (i.e., workers) and members of the general public along the routes could occur if they were exposed to low-level external radiation in the vicinity of uranium material shipments. In addition, exposure to vehicle emissions (engine exhaust and fugitive dust) could potentially cause latent fatalities from inhalation.

The risk estimates for emissions are based on epidemiological data that associate mortality rates with particulate concentrations in ambient air. (Increased latent mortality rates resulting from cardiovascular and pulmonary diseases have been linked to incremental increases in particulate concentrations.) Thus, the increase in ambient air particulate concentrations caused by a transport vehicle, with its associated fugitive dust and diesel exhaust emissions, is related to such premature latent fatalities in the form of risk factors. Because of the conservatism of the assumptions made to reconcile results among independent epidemiological studies and associated uncertainties, the latent fatality risks estimated for normal vehicle emissions should be considered to be an upper bound (Biwer and Butler 1999).[2] For the transport of conversion products and co-products (depleted $U_3O_8$, aqueous HF, and emptied cylinders, if not used as disposal containers), it is conservatively estimated that a total of about 10 fatalities from vehicle emissions could occur if shipments were only by truck and if aqueous HF product was sold and transported 620 mi (1,000 km) from the site (about 20 fatalities are estimated if HF was neutralized to $CaF_2$ and transported 620 mi [1,000 km] from the site). The number of fatalities occurring from exhaust emissions if shipment was only by rail would be less than 1 if the HF was sold and about 1 if the HF was neutralized to $CaF_2$.

Exposure to external radiation during normal transportation operations is estimated to cause less than 1 LCF under both truck and rail options. Members of the general public living along truck and rail transportation routes would receive extremely small doses of radiation from shipments, less than 0.1 mrem over the duration of the program. This would be true even if a single person was exposed to every shipment of radioactive material during the program.

Traffic accidents could occur during the transportation of radioactive materials and chemicals. These accidents could potentially affect the health of workers (i.e., crew members) and members of the general public, either from the accident itself or from accidental releases of radioactive materials or chemicals.

The total number of traffic fatalities (unrelated to the type of cargo) was estimated on the basis of national traffic statistics on shipments by both truck and rail. If the aqueous HF was sold, about 1 traffic facility would be estimated under both transportation modes. If HF was neutralized to $CaF_2$, about 2 fatalities would be estimated for the truck option and 1 fatality for the rail option.

Severe transportation accidents could also result in a release of radioactive material or chemicals from a shipment. The consequences of such a release would depend on the material released, location of the accident, and atmospheric conditions at the time. Potential consequences would be greatest in urban areas because more people could be exposed. Accidents that occurred when the atmospheric conditions were very stable (typical of nighttime) would have higher potential consequences than accidents that occurred when the conditions were unstable (i.e., turbulent, typical of daytime) because the stability would determine how quickly the released material dispersed and diluted to lower concentrations as it moved downwind.

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2 For perspective, in a recently published EIS for a geologic repository at Yucca Mountain, Nevada (DOE 2002h), the same risk factors were used for vehicle emissions; however, they were adjusted to reduce the amount of conservatism in the estimated health impacts. As reported in the Yucca Mountain EIS, the adjustments resulted in a reduction in the emission risks by a factor of about 30.

A detailed discussion of the accident scenarios modeled for the action alternatives is provided in Section 5.2.5.3. For the action alternatives, the highest potential accident consequences during transportation activities would be caused by a rail accident involving anhydrous $NH_3$. Although anhydrous $NH_3$ is a hazardous gas, it has many industrial applications and is commonly safely transported by industry as a pressurized liquid in trucks and rail tank cars.

The probability of a severe anhydrous $NH_3$ railcar accident occurring in a highly populated urban area under stable atmospheric conditions is extremely rare. The probability of such an accident occurring if all the anhydrous $NH_3$ needed was transported 620 mi (1,000 km) is estimated to be less than 1 chance in 400,000. Nonetheless, if such an accident (i.e., release of anhydrous $NH_3$ from a railcar in a densely populated urban area under stable atmospheric conditions) occurred, up to 5,000 persons might experience irreversible adverse effects (such as lung damage), with the potential for about 100 fatalities. If the same type of $NH_3$ rail accident occurred in a typical rural area, which would have a smaller population density than an urban area, potential impacts would be considerably less. It is estimated that in a rural area, approximately 20 persons might experience irreversible adverse effects, with no expected fatalities. The atmospheric conditions at the time of an accident would also significantly affect the consequences of a severe $NH_3$ accident. The consequences of an $NH_3$ accident would be less severe under unstable conditions, the most likely conditions in the daytime. Unstable conditions would result in more rapid dispersion of the airborne $NH_3$ plume and lower downwind concentrations. Under unstable conditions in an urban area, approximately 400 persons could experience irreversible adverse effects, with the potential for about 8 fatalities. If the accident occurred in a rural area under unstable conditions, 1 person would be expected to experience an irreversible adverse effect, with zero fatalities expected. When the probability of an $NH_3$ accident occurring is taken into account, it is expected that no irreversible adverse effects and no fatalities would occur over the shipment period.

For perspective, anhydrous $NH_3$ is routinely shipped commercially in the United States for industrial and agricultural applications. On the basis of information provided in the DOT *Hazardous Material Incident System (HMIS) Database* (DOT 2003b) for 1990 through 2002, 2 fatalities and 19 major injuries to the public or to transportation or emergency response personnel have occurred as a result of anhydrous $NH_3$ releases during nationwide commercial truck and rail operations. These fatalities and injuries occurred during transportation or loading and unloading operations. Over that period, truck and rail $NH_3$ spills resulted in more than 1,000 and 6,000 evacuations, respectively. Five very large spills, more than 10,000 gal (38,000 L), have occurred; however, these spills were all en route derailments from large rail tank cars. The two largest spills, both around 20,000 gal (76,000 L), occurred in rural or lightly populated areas and resulted in 1 major injury. Over the past 30 years, the safety record for transporting anhydrous $NH_3$ has significantly improved. Safety measures contributing to this improved safety record include the installation of protective devices on railcars, fewer derailments, closer manufacturer supervision of container inspections, and participation of shippers in the Chemical Transportation Emergency Center.

After anhydrous $NH_3$, the types of accidents that are estimated to result in the second highest consequences are those involving shipment of 70% aqueous HF produced during the conversion process. The estimated numbers of irreversible adverse effects for 70% HF rail accidents are about one-third of those from the anhydrous $NH_3$ accidents. However, the number of estimated fatalities is about one-sixth of those from $NH_3$ accidents, because the percent of fatalities among the individuals experiencing irreversible adverse effects is 1% as opposed to 2% for $NH_3$ exposures (Policastro et al. 1997). For perspective, since 1971, the period covered by DOT records, no fatal or serious injuries to the public or to transportation or emergency response personnel have occurred as a result of anhydrous HF releases during transportation. (Most of the HF transported in the United States is anhydrous HF, which is more hazardous than aqueous HF.) Over that period, 11 releases from railcars were reported to have no evacuations or injuries associated with them. The only major release (estimated at 6,400 lb [29,000 kg] of HF) occurred in 1985 and resulted in approximately 100 minor injuries. Another minor HF release during transportation occurred in 1990. The safety record for transporting HF has improved in the past 10 years for the same reasons as those discussed above for $NH_3$. Transportation accidents involving the shipment of $DUF_6$ cylinders were also evaluated, with the estimated consequences being less than those discussed above for $NH_3$ and HF (see Section 5.2.5.3).

#### 2.4.2.4 Air Quality and Noise

Under the no action alternative, air quality from construction and operations would be within national and state ambient air quality standards. If continued cylinder maintenance and painting are effective in controlling corrosion, as expected, concentrations of HF would be kept within air quality standards at the Portsmouth and ETTP sites. If cylinder corrosion is not controlled, the maximum 24-hour HF concentration at the ETTP site boundary could be about equal to the Tennessee primary standard of 2.9 $\mu g/m^3$ around the year 2020 (standards would not be exceeded at Portsmouth). However, because of the on-going cylinder maintenance program, it is not expected that this high breach rate would occur at the ETTP site.

Under the action alternatives, it was found that air quality impacts during construction would be similar for all three alternative locations. The total (modeled plus the measured background value representative of the site) concentrations due to emissions of most criteria pollutants — such as sulfur dioxide ($SO_2$), nitrogen oxides ($NO_x$), and carbon monoxide (CO) — would be well within applicable air quality standards. As is often the case for construction, the primary concern would be particulate matter (PM) released from near-ground-level sources. Total concentrations of $PM_{10}$ and $PM_{2.5}$ (PM with a mean aerodynamic diameter of 10 μm or less and 2.5 μm or less, respectively) at the construction site boundaries would be close to or above the standards because of the high background concentrations and the proximity of the new cylinder yard and the proposed conversion facility to potentially publicly accessible areas. The background data used are the maximum values from the last 5 years of monitoring at the nearest monitoring location (operated by the OEPA) to the site, located about 20 mi (32 km) away in the town of Portsmouth. On the basis of these values, exceedance of the annual $PM_{2.5}$ standard would be unavoidable, because the background concentration already exceeds the standard (background is 24.1 $\mu g/m^3$, in comparison with the standard of 15 $\mu g/m^3$). Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality. To mitigate impacts, water could be sprayed on disturbed areas more often, and dust suppressant or pavement could be applied to roads with frequent traffic.

During operations, it is estimated that total concentrations for all criteria pollutants except $PM_{2.5}$ would be well within standards. The background level of $PM_{2.5}$ in the area of the Portsmouth site approaches or already exceeds the standard. Again, impacts during operations were found to be similar for all three alternative locations.

Noise impacts are expected to be negligible under the no action alternative. Under the action alternatives, estimated noise levels at the nearest residence (located 0.9 km [0.6 mi] from the alternative location) would be below the U.S. Environmental Protection Agency (EPA) guideline of 55 dB(A)[3] as day-night average sound level (DNL)[4] for residential zones during construction and operations.

#### 2.4.2.5 Water and Soil

Under the no action alternative, uranium concentrations in surface water, groundwater, and soil would remain below guidelines throughout the project duration. However, if cylinder maintenance and painting were not effective in reducing cylinder corrosion rates, the uranium concentration in groundwater could be greater than the guideline at both the Portsmouth and ETTP sites at some time in the future (no earlier than about 2100). If continued cylinder maintenance and painting were effective in controlling corrosion, as expected, groundwater uranium concentrations would remain less than the guideline.

During construction of the conversion facility, construction material spills could contaminate surface water, groundwater, or soil. However, by implementing storm water management, sediment and erosion controls (e.g., temporary and permanent seeding; mulching and matting; sediment barriers, traps, and basins; silt fences; runoff and earth diversion dikes), and good construction practices (e.g., covering chemicals with tarps to prevent interaction with rain, promptly cleaning up any spills), concentrations in soil and wastewater (and therefore surface water and groundwater) could be kept well within applicable standards or guidelines.

During operations, no appreciable impacts on surface water, groundwater, or soils would result from the conversion facility because no contaminated liquid effluents are anticipated, and because airborne emission would be at very low levels (e.g., <0.25 g/yr of uranium). Impacts would be similar for all three alternative locations.

#### 2.4.2.6 Socioeconomics

The socioeconomic analysis evaluates the effects of construction and operation of a new cylinder yard and conversion facility on population, employment, income, regional growth,

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[3] dB(A) is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in the *American National Standard Specification for Sound Level Meters*, ANSI S1.4-1983, and in Amendment S1.4A-1985 (Acoustical Society of America 1983, 1985).

[4] DNL is the 24-hour average sound level, expressed in dB(A), with a 10-dB penalty artificially added to the nighttime (10 p.m.–7 a.m.) sound level to account for noise-sensitive activities (e.g., sleep) during these hours.

housing, and community resources in the region of influence (ROI) around the site. In general, socioeconomic impacts tend to be positive, creating jobs and income, with only minor impacts on housing, public finances, and employment in local public services.

The no action alternative would result in a small socioeconomic impact at both the Portsmouth and ETTP sites combined, creating a total of 130 jobs during operations (direct and indirect jobs) and generating a total of $5.3 million in personal income per operational year. No significant impacts on regional growth and housing, local finances, and public service employment in the ROI are expected.

Under the action alternatives, jobs and income would be generated during both construction and operation. Construction of the conversion facility would create 280 jobs and generate $9 million in personal income in the peak construction year (construction occurs over a 2-year period). Operation of the conversion facility would create 320 jobs and generate $13 million in income each year. Only minor impacts on regional growth and housing, local finances, and public service employment in the ROI are expected. The socioeconomic impacts would not depend on the location of the conversion facility; therefore, the impacts would be the same for alternative Locations A, B, and C.

#### 2.4.2.7 Ecology

Under the no action alternative, continued cylinder maintenance and surveillance activities would have negligible impacts on ecological resources (i.e., vegetation, wildlife, wetlands, and threatened and endangered species). No yard reconstruction is planned for either the Portsmouth or ETTP sites. It is estimated that potential concentrations of contaminants in the environment from future cylinder breaches would be below levels harmful to biota. However, there is a potential for impacts to aquatic biota from cylinder yard runoff during painting activities.

Under the action alternatives, the total area disturbed during conversion facility construction would be 65 acres (26 ha). Vegetation communities would be impacted in this area from a loss of habitat. However, for all three alternative locations, impacts could be minimized, depending on exactly where the facility was placed within each location. These habitat losses would constitute less than 1% of available land at the site. It was found that concentrations of contaminants in the environment during operations would be below harmful levels. Impacts to vegetation and wildlife would be negligible at all three locations.

Wetlands at or near Locations A, B, and C could be adversely affected at the Portsmouth site. Impacts to wetlands could be minimized depending on where exactly the facility was placed within each location. Unavoidable impacts to wetlands that are within the jurisdiction of the U.S. Army Corps of Engineers (USACE) may require a Clean Water Act (CWA) Section 404 Permit, which would trigger the requirement for a CWA 401 water quality certification from Ohio. Impacts at Location A may potentially be avoided by an alternative routing of the entrance road, or mitigation may be developed in coordination with the appropriate regulatory agency. A mitigation plan might be required prior to the initiation of construction.

Construction of the conversion facility should not directly affect federal- or state-listed species. However, impacts on deciduous forest might occur. Impacts to forested areas could be avoided if temporary construction areas were placed in previously disturbed locations. Trees with exfoliating bark, such as shagbark hickory, or dead trees with loose bark can be used by the Indiana bat (federal- and state-listed as endangered) as roosting trees during the summer. There is a potential that such trees could be disturbed during construction at Locations A or C at Portsmouth. If either live or dead trees with exfoliating bark are encountered on construction areas, they should be saved if possible. If cutting of such trees is necessary, it should be performed before April 15 or after September 15.

#### 2.4.2.8 Waste Management

Under the no action alternative, LLW, LLMW, and PCB-containing waste could be generated from cylinder scraping and painting activities. The amount of wastes generated would represent an increase of less than 1% in the loads of these wastes at the Portsmouth and ETTP sites, representing negligible impacts on waste management operations at both sites.

Under the action alternatives, waste management impacts would not be dependent on the location of the facility within the site and would be the same for alternative Locations A, B, and C. Waste generated during construction and operations would have negligible impacts on the Portsmouth site waste management operations, with the exception of possible impacts from disposal of $CaF_2$. Industrial experience indicates that HF, if produced, would contain only trace amounts of depleted uranium (less than 1 ppm). It is expected that HF would be sold for use. If sold for use, the sale would be subject to review and approval by DOE in coordination with the NRC, depending on the specific use (as discussed in Appendix E).

The $U_3O_8$ produced from conversion would generate about 4,700 $yd^3$ (3,570 $m^3$)/yr of LLW. This is 5% of Portsmouth’s annual projected volume and would have a low impact on site LLW management.

If the HF was not sold but instead neutralized to $CaF_2$, it is currently unknown whether (1) the $CaF_2$ could be sold, (2) the low uranium content would allow the $CaF_2$ to be disposed of as nonhazardous solid waste, or (3) disposal as LLW would be required. The low level of uranium contamination expected (i.e., less than 1 ppm) suggests that sale or disposal as nonhazardous solid waste would be most likely. If sold for use, the sale would be subject to review and approval by DOE in coordination with the NRC, depending on the specific use. Waste management for disposal as nonhazardous waste could be handled through appropriate planning and design of the facilities. If the $CaF_2$ had to be disposed of as LLW, it could represent a potentially large impact on waste management operations.

A small quantity of TRU could be entrained in the gaseous $DUF_6$ during the cylinder emptying operations. These contaminants would be captured in the filters between the cylinders and the conversion equipment. The filters would be monitored and replaced routinely to maintain concentrations below regulatory limits for TRU waste. The spent filters would be disposed of as LLW, generating up to 25 drums of LLW over the life of the project.

Current UDS plans are to leave the heels in the emptied cylinders, add a stabilizer, and use the cylinders as disposal containers for the $U_3O_8$ product to the extent practicable. An alternative is to process the empty cylinders and dispose of them directly as LLW. Either one of these approaches is expected to meet the waste acceptance criteria of the disposal facilities and minimize the potential for generating TRU waste through washing of the cylinders to remove the heels. Although cylinder washing is not considered a foreseeable option at this time, for completeness, an analysis of the maximum potential quantities of TRU waste that could be generated from cylinder washing is included in Appendix B, as is a discussion of PCBs contained in some cylinder coatings.

#### 2.4.2.9 Resource Requirements

Resource requirements include construction materials, fuel, electricity, process chemicals, and containers. In general, all alternatives would have a negligible effect on the local or national availability of these resources.

#### 2.4.2.10 Land Use

Under the no action alternative, all activities would occur in areas previously used for conducting similar activities; therefore, no land use impacts are expected. Under the action alternatives, a total of 65 acres (26 ha) could be disturbed for the conversion facility, with some areas cleared for railroad or utility access and not adjacent to the construction site. Up to 6.3 additional acres (2.5 ha) could also be disturbed for construction of a new cylinder yard. All three alternative locations are within an already industrialized facility, and impacts to land use would be similar for the three locations. The permanently altered areas would represent less than 1% of available land already developed for industrial purposes. Negligible impacts on land use are thus expected.

#### 2.4.2.11 Cultural Resources

Under the no action alternative, impacts on cultural resources at the current storage locations would be unlikely because all activities would occur in areas already dedicated to cylinder storage. Under the action alternatives, impacts on cultural resources could be possible at all three alternative locations. Archaeological and architectural surveys have not been finalized for the candidate locations and must be completed prior to initiation of the action alternatives. If archaeological resources were encountered, or historical or traditional cultural properties were identified, a mitigation plan would be required.

#### 2.4.2.12 Environmental Justice

No disproportionately high and adverse human health or environmental impacts are expected to minority or low-income populations during normal facility operations under the action alternatives. Although the consequences of facility accidents could be high if severe accidents occurred, the risk of irreversible adverse effects (including fatalities) among members of the general public from these accidents (taking into account the consequences and probability of the accidents) would be less than 1. Furthermore, transportation accidents with high and adverse impacts are unlikely; their locations cannot be projected, and the types of persons who would be involved cannot be reliably predicted. Thus, there is no reason to expect that minority and low-income populations would be affected disproportionately by high and adverse impacts.

#### 2.4.2.13 Impacts from Cylinder Preparation at ETTP

The cylinders at ETTP would have to be prepared to be shipped by either truck or rail. Approximately 5,900 cylinders (4,800 $DUF_6$ cylinders for conversion and about 1,100 non-$DUF_6$ cylinders) would require preparation for shipment at ETTP. As discussed in Chapter 5, three cylinder preparation options are considered for the shipment of noncompliant cylinders.

In general, the use of cylinder overpacks would result in small potential impacts. Overpacking operations would be similar to current cylinder handling operations, and impacts would be limited to involved workers. No LCFs among involved workers from radiation exposure are expected. Impacts would be similar if noncompliant cylinders were shipped “as-is” under a DOT exemption, with appropriate compensatory measures.

The use of a cylinder transfer facility would likely require the construction of a new facility at ETTP; there are no current plans to build such a facility. Operational impacts would generally be small and limited primarily to external radiation exposure of involved workers, with no LCFs expected. Transfer facility operations would generate a large number of emptied cylinders requiring disposition. If a decision were made to construct and operate a transfer facility at ETTP, additional NEPA review would be conducted.

If ETTP cylinders were transported to Paducah for conversion, the operational period at Portsmouth would be reduced by 4 years. Annual impacts would be the same as discussed for each technical discipline. No significant decrease in overall impacts would be expected.

#### 2.4.2.14 Impacts Associated with Conversion Product Sale and Use

The conversion of the $DUF_6$ inventory produces products having some potential for reuse (no large-scale market exists for depleted $U_3O_8$). These products include HF and $CaF_2$, which are commonly used as commercial materials. An investigation of the potential reuse of HF and $CaF_2$ is included as part of this EIS (Chapter 5 and Appendix E). Areas examined include the characteristics of these materials as produced within the conversion process, the current markets for these products, and the potential socioeconomic impacts should these products be provided to the commercial sector. Because there would be some residual radioactivity associated with these materials, the DOE process for authorizing release of materials for unrestricted use (referred to as “free release”) and an estimate of the potential human health effects of such free release are also considered in this investigation. The results of the analysis of HF and $CaF_2$ use are included in Table 2.4-1.

If the products were to be released for restricted use (e.g., in the nuclear industry for the manufacture of nuclear fuel), the impacts would be less than those for unrestricted release.

Conservative estimates of the amount of uranium and technetium that might transfer into the HF and $CaF_2$ were used to evaluate the maximum expected dose to workers using the material if it was released for commercial use or the general public. On the basis of very conservative assumptions concerning use, the maximum dose to workers was estimated to be less than 1 mrem/yr, much less than the regulatory limit of 100 mrem/yr specified for members of the general public. Doses to the general public would be even lower.

Socioeconomic impact analyses were conducted to evaluate the impacts of the introduction of the conversion-produced HF or $CaF_2$ into the commercial marketplace. A potential market for the aqueous HF has been identified as the current aqueous HF acid producers. The impact of HF sales on the local economy in which the existing producers are located and on the U.S. economy as a whole is likely to be minimal. No market for the $CaF_2$ that might be produced in the conversion facility has been identified. Should such a market be found, the impact of $CaF_2$ sales on the U.S. economy is also predicted to be minimal.

#### 2.4.2.15 Impacts from D&D Activities

D&D would involve the disassembly and removal of all radioactive and hazardous components, equipment, and structures. For the purposes of analysis in this EIS, it was also assumed that the various buildings would be dismantled and "greenfield" (unrestricted use) conditions would be achieved. The "clean" waste will be sent to a landfill that accepts construction debris. Low-level waste will be sent to a licensed or DOE disposal facility, where it will likely be buried in accordance with the waste acceptance criteria and other requirements in effect at that time. Hazardous and mixed waste will be disposed of in a licensed facility in accordance with applicable regulatory requirements. D&D impacts to involved workers would be primarily from external radiation; expected exposures would be a small fraction of operational doses; no LCFs would be expected. It is estimated that no fatalities and up to 5 injuries would result from occupational accidents. Impacts from waste management would include total generation of about 275 $yd^3$ (210 $m^3$) of LLW, 157 $yd^3$ (120 $m^3$) of LLMW, and 157 $yd^3$ (120 $m^3$) of hazardous waste; these volumes would result in low impacts in comparison with projected site annual generation volumes.

#### 2.4.2.16 Cumulative Impacts

The CEQ guidelines for implementing NEPA define cumulative effects as the impacts on the environment resulting from the incremental impact of an action under consideration when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7) Activities considered for cumulative analysis include those in the vicinity of the Portsmouth site that might affect environmental conditions at or near that locality under both the no action alternative and the action alternatives. Activities considered also include those at the ETTP site associated with transporting cylinders to Portsmouth (under the proposed action) and continued long-term storage of $DUF_6$ (under the no action alternative).

One action considered reasonably foreseeable under cumulative impacts is the development of a uranium enrichment facility at the Portsmouth site. An agreement between USEC and DOE on June 17, 2002, established the possibility of constructing an enrichment plant at either site. In January 2004, USEC announced that it planned to site its American Centrifuge Facility at the Portsmouth site. This EIS assumes that such an enrichment facility would employ the existing gas centrifuge technology and would generate impacts similar to those outlined in a 1977 analysis of environmental consequences that considered such an action. (The facility proposed in 1977 was never completed or operated.)

Other actions planned at the Portsmouth site include continued waste management activities, waste disposal activities, environmental restoration activities, industrial reuse of sections of the site, and the $DUF_6$ management activities considered in this EIS. Activities involving gaseous diffusion uranium enrichment at Portsmouth were discontinued early in 2002. Cumulative impacts at the Portsmouth site and vicinity would be as follows for the no action alternative and the proposed action alternatives:

- The cumulative radiological exposure to the off-site population would be considerably below the maximum DOE dose limit of 100 mrem per year to the off-site maximally exposed individual (MEI) and below the limit of 25 mrem/yr specified in 40 CFR 190 for uranium fuel cycle facilities. Annual individual doses to involved workers would be monitored to maintain exposure below the regulatory limit of 5 rem per year.

- Under the no action alternative cumulative impacts assessment, although less than one shipment per year of radioactive wastes is expected from cylinder management activities; up to 3,500 rail shipments and 4,500 truck shipments would be associated with existing and planned actions. Under the action alternatives, up to 6,800 rail shipments and 12,300 truck shipments of radioactive material could occur. The cumulative maximum dose to the MEI along the transportation route near the site entrance would be less than 1 mrem/yr for all transportation options considered.

- The Portsmouth site is located in an attainment region. However, the background annual average $PM_{2.5}$ concentration exceeds the standard. Cumulative impacts would not affect the attainment status.

- Data from the 2000 annual groundwater monitoring showed that five pollutants exceeded primary drinking water regulation levels in groundwater at the Portsmouth site. Alpha and beta activity were also detected. Good engineering and construction practices should ensure that indirect impacts associated with the conversion facility would be minimal.

- Cumulative ecological impacts should be negligible, with little change to intact ecosystems contributed by any alternative considered in this EIS in conjunction with the effects of other activities.

- Impacts on land use similarly would be minimal, with $DUF_6$ conversion activities confined to the Portsmouth site, which is already heavily developed for such activities.

- It is unlikely that any noteworthy cumulative impacts on cultural resources would occur under any alternative, and any such impacts would be adequately mitigated before activities for the chosen action would start.

- Given the absence of high and adverse cumulative impacts for any impact area considered in this EIS, no environmental justice cumulative impacts are anticipated for the Portsmouth site, despite the presence of disproportionately high percentages of low-income populations in the vicinity.

- Socioeconomic impacts under all the alternatives considered are anticipated to be generally positive, often temporary, and relatively small.

Actions planned at the ETTP site include continued waste management activities, reindustrialization of the ETTP site, environmental restoration activities, possibly other DOE programs involving the disposition of enriched uranium, and the $DUF_6$ management activities considered in this EIS. Cumulative impacts at the ETTP site and vicinity would not be large under either the no action or the action alternatives.

#### 2.4.2.17 Potential Impacts Associated with the Option of Expanding Conversion Facility Operations

As discussed in Section 2.2.7, several reasonably foreseeable activities could result in a future decision to increase the conversion facility throughput (such as by adding a fourth process line) or to extend the operational period at one or both of the conversion facility sites, although there are no current plans to do so. To account for these future possibilities and provide future planning flexibility, Section 5.2.8 includes an evaluation of the environmental impacts associated with expanding conversion facility operations at Portsmouth, either by increasing throughput or by extending operations.

The throughput of the Portsmouth facility could be increased either by making process efficiency improvements or by adding an additional (fourth) process line. As described in Section 5.2.8, a throughput increase through process improvements would not be expected to significantly change the overall environmental impacts when compared with the current plant design (three process lines). Efficiency improvements are generally on the order of 10%, which is within the uncertainty that is inherent in the impact estimate calculations. Slight variations in plant throughput are not unusual from year to year because of operational factors (e.g., equipment maintenance or replacement) and are generally accounted for by the conservative nature of the impact calculations.

In contrast to process efficiency improvements, the addition of a fourth process line at the Portsmouth facility would require the installation of additional plant equipment and would result in a nominal 33% increase in throughput compared with the current base design. The plant capacity would be similar to the capacity planned for the Paducah site (evaluated in DOE/EIS-0359). This throughput increase would reduce the time necessary to convert the Portsmouth and ETTP $DUF_6$ inventories by about 5 years. The construction impacts presented above and summarized in Table 2.4-1 for three process lines would be the same if a fourth line was added, because a fourth line would fit within the process building.

In general, a 33% increase in throughput (e.g., by the addition of a fourth line) would not result in significantly greater environmental impacts during operations than those discussed above and summarized in Table 2.4-1 for three process lines (impacts associated with expanded operations are shown in brackets in Table 2.4-1 where they would differ from those presented for the proposed design). Although annual impacts in certain areas might increase up to 33% (proportional to the throughput increase), the estimated annual impacts during operations would remain well within applicable guidelines and regulations, with collective and cumulative impacts being quite low.

One exception is the $PM_{2.5}$ concentration during construction, which could exceed standards because of the regionally high background level under both three- and four-process-line cases. The background data used are the maximum values from the last 5 years of monitoring at the monitoring location nearest to the site (operated by the OEPA), located about 20 mi (32 km) away in the town of Portsmouth. On the basis of these values**,** exceedance of the annual $PM_{2.5}$ standard would be unavoidable, because the background concentration already exceeds the standard (background is 24.1 $\mu g/m^3$, in comparison with the standard of 15 $\mu g/m^3$).

Because a 33% increase in throughput would reduce the operational period of the facility by approximately 5 years, positive socioeconomic impacts associated with employment of the conversion facility workforce would last approximately 13 years, compared with 18 years under the base design.

The conversion facility operations could also be expanded by operating the facility longer than the currently anticipated 18 years. There are no current plans to operate the conversion facilities beyond this period. However, with routine facility and equipment maintenance and periodic equipment replacements or upgrades, it is believed the conversion facility could be operated safely beyond this time period to process any additional $DUF_6$ for which DOE might assume responsibility. As discussed in Section 5.2.8, if operations were extended beyond 18 years and if the operational characteristics (e.g., estimated releases of contaminants to air and water) of the facility remained unchanged, it is expected that the annual impacts would be essentially the same as those presented above and summarized in Table 2.4-1. The estimated annual impacts during operations are generally within applicable guidelines and regulations, with collective and cumulative impacts being quite low. This would also be expected during extended operations. The overall cumulative impacts from the operation of the facility would increase proportionately with the increased life of the facility.

## 2.5 PREFERRED ALTERNATIVE

DOE's preferred alternative is to construct and operate the proposed $DUF_6$ conversion facility at alternative Location A, which is located in the west-central portion of the Portsmouth site.